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LOCAL EVENTS

GLOBAL IMPACTS

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Click BACK TO CONTENTS to go to the Table of Contents page

BACK TO CONTENTS

EDITORIAL

The history of the Earth is rich with examples of local events with global impacts. Recent research has confirmed that the impact of a large asteroid or comet in the Yucatán Peninsula in Mexico 66 million years ago, wiped out dinosaurs off the surface of our planet since it hit around a time sea level rise and active volcanism had made these animals more susceptible to extinction. More recently, some 74,000 years ago, the Toba super-eruption in the island of Sumatra, Indonesia, resulted in a noticeable decrease – even if short-lived – in global average temperatures.

Given the importance of local events with global consequences in the geosciences, we are dedicating this issue of the EGU newsletter to this theme.

In the Articles section, Jonathan Fuhrmann explores how salinity changes in the Mediterranean can bring about climatic changes on a global scale. In her article, Amanda Gläser-Bligh takes a different view on the theme by looking into how gas flaring affects the Arctic and how a global solution is needed to reduce the burn off of natural gas. Adam Booth tackles the question of our 'alien origins', writing about how local meteorite impacts may hold the key to the emergence of life on Earth. Becky Summers' article focuses on research in the West Antarctica Ice Sheet, the area that is contributing the most to global sea level rise at present.

In his quarterly contribution, the EGU President Günter Blöschl writes about local and global water issues, encouraging an interdisciplinary approach to solving them. You can read his article in the EGU Voice section.

On the Education section, we focus on an annual event in Vienna that is bringing about international changes in geoscience teaching, the GIFT (Geosciences Information For Teachers) workshop. Representatives from the EGU Committee on Education report on the 2014 edition of GIFT, which focused on Our Changing Planet.

The Young Scientists section is dedicated to early-career researchers' involvement in policy. By providing usable scientific information to their local representatives, researchers can influence policymaking on issues relating to global change.

Other sections of the newsletter, while not directly related to the general theme of this GeoQ, are equally relevant. In EGU News, for example, we inform EGU members about our journals' new impact factors, among other news. We also highlight the EGU 2015 call for sessions. Our annual General Assembly is another example of a local event with a global impact, at least in what scientific presentation and discussion are concerned! This is your chance to play a role in shaping the scientific programme of the conference, so make sure you submit your suggestions online before 12 September.

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The current and previous editions of the EGU newsletter (GeoQ and The Eggs) are available online at www.egu.eu/newsletter.

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COVER PHOTO: Untouched nature in the Antarctic (Credit: Eva Nowatzki, distributed via imaggeo.egu.eu)

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A small sea at large: Mediterranean controls on global climate

In the late 1990s, R. G. Johnson noted that the Aswan Dam on the river Nile was causing the Mediterranean Sea to become more saline. He suggested far-reaching implications for global climate, including the formation of a new ice sheet in Canada – all because of the saltier water flowing from the Mediterranean into the Atlantic. In fact, he went so far as to propose a dam across the Strait of Gibraltar to stop this from happening.

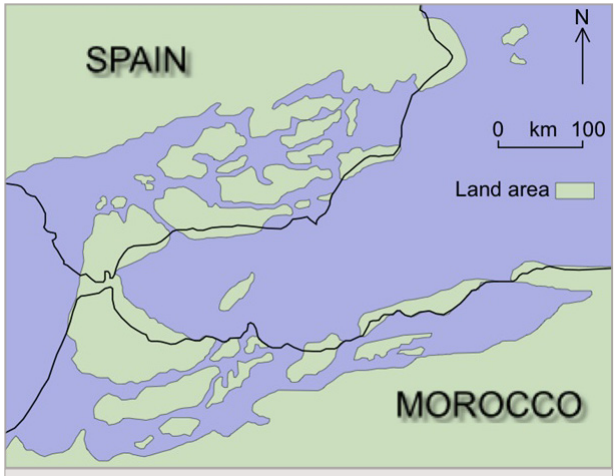
Oceans form an integral part of the global carbon cycle and also serve as a major heat sink – clearly, they play a pivotal role in the global climate system. But can a change in the salinity of a small sea such as the Mediterranean really bring about climatic change on a global scale?

Models of the present day suggest that this is indeed possible. Relatively warm, saline (and therefore dense) Mediterranean outflow water enters the Atlantic at depth and strengthens the deep-ocean part of the thermohaline circulation, the 'global conveyor belt' of currents that move water around the world. The long timescales (centuries) on which the thermohaline circulation changes, however, mean that past events may yield useful insights about potential consequences of fluctuations in Mediterranean outflow water.

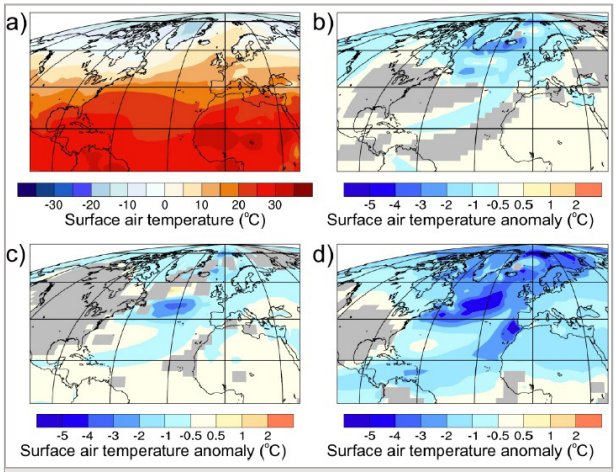
Ruza Ivanovic and her team have investigated a particularly pertinent case study of how changes in the Mediterranean have driven global climate in the past. During the so-called Messinian Salinity Crisis (MSC) between 5.96 and 5.33 million years ago, sediments show that the Mediterranean Sea underwent severe fluctuations in temperature and salinity. It may even have dried up completely at several points during this period! The team use a sophisticated general circulation model (GCM) to simulate changes in Mediterranean outflow water into the Atlantic and their global-scale climatic impact during the MSC. The results are published in Climate of the Past.

Ivanovic and her colleagues had to calibrate their GCM to simulate what Earth was like over 5 million years ago. Back then, our planet was warmer and wetter on average and the Himalayas and Rocky Mountains were lower, so the distribution of vegetation – an important carbon sink – was different. The Antarctic and Greenland ice sheets were smaller than they are today, so sea levels were 25 m higher. Finally, the Central American Seaway between North and South America was still open and the thermohaline circulation was weaker. All these changes mean that fluctuations in the Mediterranean had a greater impact on global climate back then than they would today.

The researchers first ran their 'Messinian' GCM for a period of 2,400 years to allow a steady state to emerge. From this steady state, they simulated several different extreme scenarios of Mediterranean hypersalinity, freshening (becoming less saline) and different outflow strengths, and compared their outcomes to a control scenario with no changes.



The Messinian Salinity Crisis is thought to have been caused by extreme restriction of the exchange between the Mediterranean and the Atlantic. The black lines show the present-day Strait of Gibraltar as delineated by the coasts of Spain and Morocco. During the salinity crisis, the green land areas limited flow. (Credit: Ivanovic)



Surface air temperatures during the initial steady state are shown here in panel a). Panels b) and c) show changes relative to this steady state in two different scenarios with elevated Mediterranean salinity levels, while panel d) shows what happens if the Mediterranean freshens. (Credit: Ivanovic et al., 2014)

Ivanovic and her team found that if the Mediterranean were to dry up so that no water enters the Atlantic, the Labrador Sea east of Newfoundland would become warmer, raising temperatures across Canada. In the Messinian, then, damming the Mediterranean as Johnson proposed would indeed have prevented the formation of a new Canadian ice sheet.

Increasing Mediterranean salinity (and therefore increasing density) produces marked cooling in the north Atlantic and over Canada, Greenland and Europe. Dense, deep water normally flowing south from the far northern Atlantic is essentially replaced by Mediterranean outflow water so that the northern latitudes remain cooler.

Conversely, a freshening Mediterranean becomes less dense than the Atlantic, meaning that water flows into the ocean at the surface rather than at depth. The entire Atlantic water column freshens, with extreme and widespread consequences. The thermohaline circulation breaks down completely in the Atlantic, so warm, tropical water no longer reaches higher latitudes. Cool, fresh water even spreads into the Pacific through the Central American Seaway. As a result, the entire northern hemisphere cools by as much as 8 °C. On the other hand, parts of the southern hemisphere experience some warming because cold, north Atlantic water is no longer transported south.

The Earth was a very different place during the MSC than it is now, so naturally the results Ivanovic and her colleagues obtained differ from studies looking at present-day climate. Then as now, however, it is clear that R. G. Johnson was not exaggerating when he claimed that the Mediterranean could wreak havoc with global climate. It remains to be hoped that potential far-reaching impacts are considered when planning future mega-projects like the Aswan Dam.

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Local flaring, global impacts: modelling Arctic black carbon

Although most of the Earth's population isn't aware of it, the Arctic is burning. The flames are being fed by natural gas produced as a by-product of crude oil extraction, which is then flared away at the surface. Although practiced worldwide, high-latitude gas flaring has the greatest impact on the fragile Arctic environment. Since the black carbon emissions resulting from flaring know no national boundaries, only a global solution will bring about results to improve conditions in the Arctic.

Modelling black carbon

Black carbon (soot) and other combustion emissions from flared natural gas are released into the Earth's atmosphere where they move in patterns that atmospheric scientists try to model. However, standard models have trouble predicting the patterns of black carbon transport into the Arctic. This has been confirmed by Andreas Stohl of the Norwegian Institute for Air Research and his collaborators. According to their research, published in Atmospheric Chemistry and Physics, the atmospheric concentration of black carbon found in the Arctic is underestimated by all existing models.

What makes the Arctic atmosphere so difficult to model? It is a combination of factors, including the complex seasonal changes that occur in higher latitudes (above 40 degrees). The relative inefficiency of aerosol removal in late winter and spring, known as the Arctic Haze phenomenon, also complicates the modelling process.

The flaring of natural gas impacts the Arctic (Credit: Fabien Darrouzet, distributed via imaggeo.egu.eu)

"It is the removal of black carbon from the atmosphere that is so difficult to model. Black carbon is mainly scavenged by precipitation, which is relatively inefficient in the period between January and March, but the deposition is not very well modelled and the existing models do not show enough black carbon being transported into the Arctic in relation to ground measurements," said Stohl.

The politics of flaring

It is not always clear how much associated natural gas will be produced from an oil well, and it may change in amount, quality and chemical composition over the life of a field. Producers often find

Flaring gases from an oil platform in the North Sea. (Credit: Wikimedia Commons user Varodrig)

that the easiest way to deal with the less economical, and sometimes contaminated, gas is to burn it on site by means of flaring. There are several alternatives, but no cookie cutter solution to the problem, as each area has unique issues in terms of geography, geology and infrastructure.

Russia and Nigeria lead the list of countries with the most flaring activity, with 66 billion cubic metres, or 24% of the overall associated Russian production, flared in 2010. But flaring occurs all over the world. The World Bank estimates that 140 billion cubic metres of associated gas is burned or wasted annually. This is equivalent to about a third of EU gas use and, in terms of CO_2 emissions, it equates to taking 70 million cars off the roads.

The issue is most serious in places where infrastructure development and investment is difficult, especially on brownfield sites and remote locations. It is especially bad for the Arctic, where the combusted black carbon particles settle on the snow and increase the snow-albedo effect, which causes further melting of Arctic ice. Atmospheric warming is also increased by black carbon over the highly reflective surface of the Arctic.

Tracking flaring activities

Historically, it was only possible to track flaring activities through the limited data gathered from companies and governments reporting on local hydrocarbon industries. But this information tends to be incomplete for political reasons. It is now possible to follow black carbon emissions through observation of the black carbon/carbon monoxide emissions ratio, which is specific to certain sources such as diesel vehicles, biomass burning or flaring. Carbon monoxide is another combustion by-product. It remains in the atmosphere over several weeks to months, sometimes longer, and is often used to trace polluted air masses.

It is also possible to track flaring via satellite. A Japanese satellite named IBUKI is able to collect infrared information and detect CO_2 and methane emissions. The collected data can be cross-referenced with additional data points. This is one step closer to a complete picture, but it is not perfect: no completely reliable information on flaring as it occurs is yet available.

"New satellites can detect temperature signals and have the capacity to not only exactly pinpoint where flaring is happening but to also quantify the gas volumes burned by each flare, which is really needed to estimate the flaring emissions. This technology is also capable of distinguishing between flaring and other sources like forest fires, based on temperature measurements, as flares are extremely hot. Thus, we expect that estimates of flaring emissions will become much more reliable in the near future," Stohl said.

Sources of black carbon

Where is the black carbon most likely coming from? This depends on specific latitude, location and season. Some models show that flaring emissions are dominating at latitudes above 66 degrees (up to 80%) in winter. It can be assumed that flaring is the main producer of black carbon during this time, as biomass burning, one of the other big black carbon contributors, is less frequent in the winter. Residential, transport and industry are the major polluters in the middle latitudes, with aircraft and international shipping contributing to a much lesser extent.

Although flaring occurs globally, the impacts from Russia have a proportionally large impact on the Arctic compared to flaring from lower latitudes. When flaring occurs along the main low-level pathway of air masses directly entering the Arctic from Siberia, black carbon emissions are measured at their highest levels. According to the models, this makes Russia responsible for a large fraction of black carbon loading in the Arctic lower troposphere. Russia also has strong flaring at very high latitudes and Northern Russia has the highest measurements of black carbon concentrations in snow.

Flaring in the Siberian oil fields has been occurring for decades and can generally be attributed to coordination problems and conflicting interests. The Russian presidency has raised this as an issue and has suggested that companies that flare pay large fines, and new laws require companies to use a high percentage of associated gas. The government has also allowed preferred access to the electricity grid for power generated from flare projects and has encouraged use of gas for local power generation, which is often needed in remote regions to supply power to processing plants.

What can be done to reduce flaring?

The problem will only get worse as more and more Arctic areas are opened up for drilling activities and will take on a more international aspect as other areas of the Arctic are exploited.

There are a number of ways to combat natural gas flaring, but since there is no one-size-fits-all solution, a number of organisations need to come together to ensure a balance amongst government, business and private interests. Assumptions that associated gas is not worth gathering need to be challenged. So far, the best efforts to eliminate flaring look at the entire gas value chain and involve a combination of penalties, incentives, investment and inventive uses for the available gas.

For the Arctic, the role of both the scientific and international communities is of vital importance. As the Arctic has no single authority, international institutions and Arctic groups will be vital in supporting commitments to mitigate flaring activities. And as technology advances, there is also the hope that new methods and processes to deal with flared gas will become available. Since there are a number of ways to reduce flaring, this is a realistic and achievable step towards decreasing the presence of black carbon in the Arctic, most possibly in the next ten years. It is another step towards changing local behaviours that have tremendous global impacts.

Amanda Gläser-Bligh
Geologist and member of ELEEP, Emerging Leaders in Environmental and Energy Policy Network

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Molecules and meteorites: big impacts for life on Earth

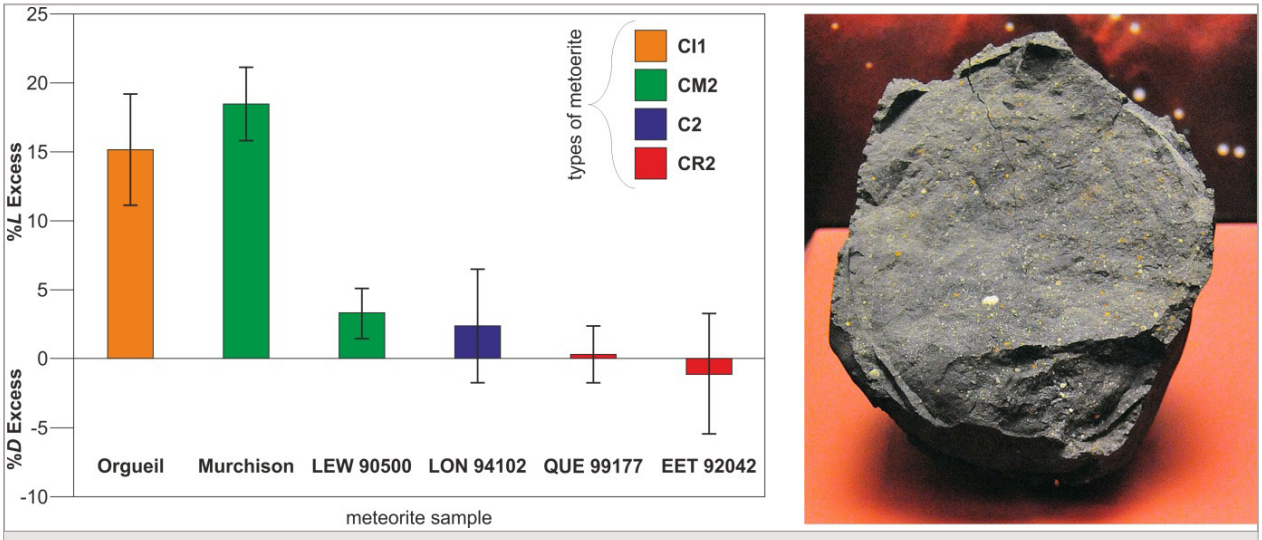
You'd be forgiven for thinking that meteorite impacts only spell disaster for life on Earth, and there is plenty of evidence to suggest that an impact was bad news for the dinosaurs. However, a growing body of research suggests that asteroid and comet impacts early in our planet's history may actually hold the key to the origins of life on Earth. In terms of the global impact of a local event, they surely don't come much bigger than this.

As a geophysicist, I'm well aware of the problems that researchers in my field face in delving back in time to establish the geology of the early Earth. The challenge of doing a similar thing with organic molecules, which I guessed would be rather more ephemeral than the Earth's tectonic plates, seems a daunting prospect! Nonetheless, there are plenty of active researchers in this field, including at NASA and the European Space Agency (ESA). One academic collaborating with these organisations is Zita Martins at the Department of Earth Science and Engineering of Imperial College London. Ahead of her attendance to a symposium on the origins of life, I met with her to get some perspective on the extra-terrestrial influences on the beginnings of life on Earth.

The question of our 'alien origins' is usually taken with a good pinch of salt, as Martins explains. "It's important to appreciate that we're not talking about life being formed somewhere else in space and then being brought to Earth." However, it is entirely possible that the carbon-rich organic molecules contained within asteroids and comets, and delivered to Earth at the point of impact, do have a role to play in the initiation of life on our planet – and unpicking this biological history is a fascinating and multi-disciplinary science. Martins describes herself as an astrobiologist, but she has a background in chemistry and an understanding of physics and geology. "The beauty of astrobiology is that it draws together scientists from different fields, all trying to answer two big questions: how did life originate here on Earth, and is there life in other parts of our solar system?"

Zita Martins and a sample of space – in the lab at Imperial College London

So, what are the origins of life on Earth? There are a few theories which sit alongside a meteorite impact, including chemical reactions taking place around sea-floor hydrothermal vents. While Martins is happy to accept that there's room for contributions from many processes, she is drawn to a cosmogenic explanation in part because of a set of observations in our geological record. "We know that between 4.6 and 3.8 billion years ago the Earth suffered a heavy bombardment of comets and asteroids." Indeed, our whole neighbourhood was a risky place to be at this time, as there is evidence in craters on its surface that the Moon suffered the same astrophysical assault. "Geological records then show that life originated on Earth around 3.5 billion years ago," give-or-take the uncertainty in the geological dating method. So – cause and effect, or cosmic coincidence? Martins smiles: "As a scientist, I can't believe in coincidences!"



Bias towards *L*-isovaline amino acid in samples of several meteorites, as measured by Glavin and Dworkin (2009): positive percentages on the y-axis suggest that *L*-isovaline is dominant over *D*-isovaline in a sample. The bias is particularly strong in samples of the Murchison meteorite, a fragment of which is shown on the right. (Credit: Glavin and Dworkin, 2009 & Wikimedia user Basilicofresco)

The impact theory says that when a comet or asteroid strikes our planet, the pressure and temperature at the impact site are sufficient to set off a string of reactions among the molecules already on Earth and those within the meteorite. Among the results: amino acids – the components of proteins that are the building blocks of life. For Martins, it's no surprise to see the geological signatures of life taking hold in the period following a heavy bolide bombardment.

However, if the theory is sound, you might expect life on Earth to share some biochemistry with that of the amino acids held within asteroids and comets. Fortunately for astrobiologists, a frequent supply of meteorites rains samples of cosmogenic amino acids onto the Earth's surface. The biggest impact that these usually make is on the media (something that the residents of Chelyabinsk Oblast may dispute, following events of 2013) but even the smallest samples of certain meteorites are packed full of organic molecules, including amino acids, themselves a record of the early chemistry of space.

Certainly, the amino acids involved in our own biology are present within the extra-terrestrial samples. However, the reverse isn't true: while around 80 amino acids have been identified in meteorites (Martins and Septhon, 2009), biological organisms on Earth only use around a quarter of them. Nonetheless, there are subtle links in our own biology to molecular signatures in extra-terrestrial amino acids – and here, we enter the world of 'CSI: Outer Space'.

The clue concerns the chirality of a molecule – essentially, whether it is right- or left-handed. "Put your hands out in front of you," Martins explains (and naturally, I follow the instruction). "Your hands are mirror images of each other, so you cannot superimpose them – your thumbs are on opposite sides." It's the same with amino acids, which exist in left-handed (*L*-) and right-handed (*D*-) forms. On Earth the vast majority of organisms use *L*-amino acids, whereas meteorites contain *D*- and *L*-amino acids. Why is life so selective? It's possible that our biological preference for *L*-amino acids is the result of the chiral distribution of cosmogenic amino acids. Key evidence is given by the amino acid isovaline. *L*-isovaline is non-proteinogenic: it is not involved in any biological process on Earth, therefore any

Artist impression (not to scale) of ESA's Rosetta approaching comet 67P/Churyumov-Gerasimenko. (Credit: spacecraft: ESA/ATG medialab; comet image: ESA/Rosetta/NAVCAM)

L-isovaline detected in meteorites cannot be a terrestrial contaminant. Observations show that the split between *L*- and *D*-isovaline is not fifty-fifty and, as shown in the graph at the top of the page, the samples present in meteorites are somewhat biased towards left-handed chirality. This bias is particularly evident in samples of the Murchison meteorite (pictured) which impacted Australia in September 1969. Martins suggests that "this little bit of excess of the *L*-form could have been enough to expand the use of *L*-amino acids in biological organisms on Earth."

Of course, the reason for the chiral imbalance of amino acids is yet to be explained, and Martins also questions why life on Earth makes use of only a few more than 20 amino acids when there is such diversity available in space. Nonetheless, I find this molecular form of evolution quite elegant, and it's amazing to think that our basic biochemistry has a direct link to a process occurring some 3.6 billion years ago.

If external processes hold the key to life on Earth, then why not life elsewhere? The icy moons of Saturn and Jupiter are prime candidates, since they are likely to contain organic molecules of their own and have certainly faced asteroid impacts at some point in their history. Astrobiology is now sampling further afield. Both NASA and ESA have probes journeying to asteroids and comets, such as

Rosetta (pictured), and ESA's JUICE mission will target Jupiter's icy moons. There is every chance of new insights into deep-space chemistry.

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Chasing ice: studying the stability of the Western Antarctica Ice Sheet

Out of all the world's glaciers, Pine Island Glacier (PIG) is currently making the single biggest contribution to global sea level rise. Scientists are trying to figure out why.

Clinging onto the edge of western Antarctica, PIG is the fastest shrinking glacier on the planet. With 56 Gt of ice careering into the ocean each year, knowing the future stability of the ice sheet is essential.

"The West Antarctica Ice Sheet (WAIS) is a glaciological hotspot," says Andy Smith who works at the British Antarctic Survey (BAS) in Cambridge, UK. "At the moment, the area is contributing the largest amount to global sea level rise – at around 3 mm per decade. Although this doesn't sound much, the little changes add up over time."

With the return of the sun to the southern continent, scientists from BAS are kicking off the 2014 PIG research season. They will be setting off on the second of a 1000 km trek across the ice to measure snow accumulation at the top of the glacier. As they go, they will record snow density, collect ice cores and gather historical clues from rocks and isotopes to see how fast PIG is changing. "Over the six-year period we have been studying the melting so far, it has been getting worse," says Smith. "However what we don't know is if this is going to carry on or even off."

Living on the ice

To answer this question, the team will be spending 70 days living on the ice in temperatures barely reaching above -10 °C. Going out into the field involves transporting 80 tonnes of equipment including two tractors, tents, science kits and a shipping container, revamped into a dining room.

"Doing this means the science can happen more efficiently," says Simon Garrod, Field Operations Manager at BAS. "When you're living in the snow, a significant amount of time must be spent just living – pitching tents and melting snow for water. Being able to pull your dining room along with you means you have more time for science."

Tractor traverse on Pine Island Glacier. (Credit: Damon Davies)

By pitching their tents at such chilly latitudes, they hope to figure out what's going on at PIG. "The reason why we think its changing so fast is because it's being forced by what's happening in the ocean," says Smith.

As warm water currents in the Amundsen Bay meet the underside of glacier's ice shelf, they speed up the melt. The amount of ice loss more than doubled in the past couple of decades. Ice discharge between 1992 and 2011 was reported at an average of 20 Gt per year but is now reaching 56 Gt per annum, which is equivalent to removing a block of ice 100 metres deep and about 1000 square kilometres wide from the ice shelf each year.

The WAIS is more vulnerable to oceanographic changes than the eastern side because the sheet sits on ground below sea level. The grounding line, the point where the ice lifts off the bed rock and starts

GPS stations on the glacier with the base camp in the background. (Credit: Jan De Rydt)

to float, has retreated by tens of kilometres. For example, between the same period of 1992 to 2011, Rignot et al. (2014) suggest PIG retreated 31 km at its centre. This means it was 400 metres deeper below sea level in 2011 than in 1992. As the ice recedes, the ocean drains into the grooves at the bottom of the glacier, which reduces the friction on the glacier bed. The ice starts to fast-track downhill into the sea. "It's like removing the brakes," says Smith.

The PIG team setting out in October are part of a larger project called the Ice Sheet Stability Research Programme, or iSTAR, of which Smith is the Science Programme Manager. As part of this project, data from nunataks – exposed areas of rock peaking out of the ice – will be combined with information collected by atmospheric balloons, by airplanes dropping sensors in crevasses and by ships, which will create the most integrated picture of a glacier ever attempted. "BAS is doing what no one has done before by studying the ice and the ocean in an integrated method of the whole system," says Smith.

Curious assistants

Hungry elephant seals are also playing their part to fill in the missing data gaps. Last year, scientists tagged female elephant seals with ocean profile collectors. As the seals dive down to hunt for food, the tags collect data on conductivity, temperature and depth. When they resurface, the data are beamed back via satellites to the University of St Andrews, UK.

"The seals give us a mass of data in places we just can't get to observe," says Michael Fedak, a biologist from the University of St Andrews. "They have been working their tails off since we tagged them."

The seals have so far collected almost 9000 ocean profiles around the edge of the ice shelf. In comparison, the ship in the same location managed to gather 120 profiles.

Being able to tag the females gave the researchers an unexpectedly complete record. Only male elephant seals had previously been seen on Edwards Island near the mouth of the glacier as they complete their annual moult. But males have one downside: they have the habit of going on a mid-winter break from feeding to take a rest onshore.

The females are different. They are out hunting at sea for long periods of time and do not require a break, diving intensively for up to 300 days to put on weight for breeding. So for the data record, this means a more comprehensive and uninterrupted profile.

"We were really surprised to find the females in [Amundsen] Bay. They are doing something not seen anywhere else so far south in the world – benthically feeding at the front of the glacier," says Fedak. "This was an odd place, as usually at this time of year the females are far out at sea intensively feeding and putting on body fat ready for producing pups – which use up to 35 per cent of their body mass."

Close-up of juvenile southern elephant seal. (Credit: Serge Ouachée)

The observations are combined with a wide range of oceanographic sampling methods from ship transects, sea gliders and underwater submarines. The information gathered from the water bordering the glacier will help the scientists build models to predict how much of WAIS could be heading seaward.

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Freelance science writer

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Letter from the EGU President

The global water crisis and the emergence of socio-hydrology

In his quarterly message, the EGU President emphasises the need to work in an interdisciplinary way to understand the long-term interplay between the natural water system and the human water system, which is needed to address both local and global water issues.

The European Geosciences Union deals with many subjects that are of enormous relevance to society. Mineral resources, climate and natural hazards, to name a few, are high on the political agenda. It is clear that a better understanding of the underlying processes may lead to more informed and more efficient decision making. Water, hailed as one of the grand challenges facing humans in the modern era, is among the hot topics in the 21st century. What is referred to as the global water crisis summaries an issue people have to face in many parts of the world at the local scale. Globally, 1.1 billion people lack access to an improved water supply and 2.4 billion lack improved sanitation, with more than 3 million people dying per year as a result.

While drinking water and water for household consumption and industry are very often a local and regional problem, it is irrigation that dominates water use at the global scale. Still, on a global average, much more water is available than is actually consumed: about 6400 m³/yr/capita runs off in the water catchments of the world, with only a fraction of that being used by humans. However, this is just an average. The actual values of available water vary considerably in space and time: over the high and low runoff regions of the world, and through the high and low runoff seasons.

When water demand is greater than the available resource, as is the case in some areas of north-west India, China, northern Africa, and the southern United States, water scarcity prevails. If the consumption, measured as the water volume per year that is extracted from rivers and groundwater, exceeds the annual replenishment, the water use is unsustainable, leading to falling ground water tables and reduced streamflow. These trends may be exacerbated by population dynamics – increasing population translating in increases in water demand – and life-style changes. For example, in China the per capita meat consumption has increased almost threefold in the past three decades which has resulted in exponential increases in water demand.

Local and global water issues are naturally monitored by water managers, who have a portfolio of options to address them:

- Technical approaches, including more efficient irrigation methods (e.g. drip irrigation instead of sprinklers), water storage and water transfers (to balance the temporal and spatial variability of water availability), and sanitation measures.
- Organisational approaches of integrated water resource management, using only renewable resources (i.e. sustainable water use), cross-sectorial management strategies (e.g. agriculture, industry, households), and demand management (e.g. providing incentives to users to use less water).
- Economic approaches, such as water pricing, trading water permits and strengthening the economy. The latter is particularly relevant in areas where water scarcity is not due to a lack of freshwater resources but to an inability to use these resources efficiently due to economic reasons (such as in much of subsaharan Africa and parts of northern India).
- Political, legal and social approaches, where the focus is on setting up an appropriate governance structure to support integrated water resource management, strengthening the role of water management within relevant sectors, raising awareness of the role of water resources, and improving education.

In all of these approaches, the physical aspects of freshwater are only one component of the entire problem. They are closely intertwined with the human components associated with the technical, organisational, economic, political, legal and social facets of the issue.

Traditionally, the scenario approach has underpinned the decision making process in water management. Here, the term scenario is

Men and children withdraw water for irrigation in the Dogon plateau (Mali) during a sandstorm day. Ensuring the population has safe and sustainable access to water is one of the major challenges in the region. (Credit: Velio Coviello, distributed via imaggeo.egu.eu)

Historically, windmills have been used for keeping the water levels down in polders in the Netherlands. (Credit: Anna Nadolna, distributed via imaggeo.egu.eu)

used in the geoscientific sense: as a synonym for a forecast, or a number of alternative forecasts or projections each of which includes (rather than excludes) the main uncertainties. This kind of scenario approach is often used in water management with certain assumption on water demand, water availability, and their space-time distribution. On the basis of these scenarios (and other factors such as politics) decisions are taken to manage the water resources in some optimum way.

While the scenario approach has served us well for decades, there is now growing awareness that it may not embrace the full spectrum of the possible futures of the water system. Importantly, the human factors (technical, organisational, economic, political, legal and social aspects) are almost always prescribed as a boundary condition, i.e. as an external forcing. This does not allow for long-term, dynamic feedbacks between the natural water system and the human water system to be captured. However, in a planet where humans have changed almost all aspects of the world, these feedbacks may, in fact, be the main control on how the system evolves. We are living in the Anthropocene, the era when the human footprint is omnipresent, so treating humans as mere boundary conditions may be anachronistic and may not lead to desirable decisions. Natural scientists cannot continue to ignore the human factor.

Therefore, to understand water cycle dynamics over long timescales, we need to take into account the interactions and feedbacks with human systems. This new way of thinking, of treating humans as part of the system rather than as an external factor, has given rise to the emergence of 'socio-hydrology', a science aimed at understanding the dynamics and co-evolution of coupled human-water systems.

The defining characteristics of socio-hydrology over the traditional way of dealing with people and water are the following:

- Capturing feedbacks of the human-natural water system in a dynamic way, going beyond the traditional practice of prescribing human factors as external. The essence of socio-hydrology is the co-evolution of humans and water. A co-evolutionary system includes a general process of generating a 'new variation', with new variations or 'emergent behaviour' being brought about by feedbacks between processes at a range of scales. This may lead to exceedance of 'tipping points', which may result in systems evolving into new, potentially unobserved, states.
- Quantifying system dynamics in a generalisable way. The traditional scenario approach has always been context dependent and tailor made to the local conditions. While for the immediate decision making this is undoubtedly essential, for a more long-term view of the scientific approach one would hope to learn from other cases, to abstract a more uniform knowledge base. This knowledge base should be quantitative to go beyond the traditional practice of dealing with the human factors in a qualitative way. In fact, there have already been a few early attempts of proposing coupled differential equations to represent the system dynamics, including the social system.
- Not necessarily predictive. The coupled human-nature system is inherently non-linear and this non-linearity may prohibit full predictability. Lack of predictability doesn't come as a surprise if one looks at the history of humankind, so predictability should not, in fact, be expected. However, the socio-hydrologic approach may still be predictive in a statistical sense, as are other non-linear systems researched in the geosciences. Perhaps even more importantly, the emergent behaviour, the possible futures that would not easily be predicted by traditional forecasts, may prove extremely important for decision making, and very interesting from a scientific perspective in its own right.

Socio-hydrology may pursue a number of lines of enquiry. An historical perspective would be to learn from reconstructing and studying the past, while in comparative socio-hydrology one learns from the similarities and differences between catchments in different places. Process socio-hydrology, on the other hand, focuses on studying a small number of real human-water systems in detail to gain more fundamental insights into causal relationships.

The 21st century water problems are complex, involving feedbacks across multiple scales, sectors and agents. Addressing these complicated issues requires radical new ways of thinking and it is fundamental to focus on co-evolution and emergent patterns, without forgetting the unexpected. Socio-hydrology implies a change in the way we research and teach as humans begin to play a much bigger role in water cycle dynamics. To generate viable solutions to the water challenges we face today, it is fundamental to carry out such joint efforts.

Socio-hydrology embraces processes beyond the purely physical, chemical and biological relationships, shifting the science towards more holistic descriptions, with process interactions becoming increasingly important. In fact, there may be a lesson learned here for other geosciences beyond hydrology. The human imprint is certainly not limited to freshwater, it is omnipresent. Other areas of the geosciences within the EGU may face similar challenges. We need to work in an interdisciplinary way to understand the long-term interplay of humans and geoprocesses, which are needed to address a plethora of both local and global management issues. It may no longer suffice to treat humans as boundary conditions in an isolated way but as an integral part of the coupled human-nature system when advancing Earth system sciences in the Anthropocene.

Günter Blöschl
EGU President

Division reports

News brought to you from four EGU divisions

In each edition of GeoQ division presidents or deputy presidents contribute reports that update EGU members with news from their divisions. Issue 11 gives voice to Gerrit de Rooij (Hydrological Sciences), Shaun Lovejoy (Nonlinear Processes in Geosciences), Johan van der Molen (Ocean Sciences) and Özgür Karatekin (Planetary and Solar System Sciences).

HS Hydrological Sciences

For the first time, the 2014 General Assembly had a theme: The Face of the Earth. Hydrological processes clearly play their part in shaping this face but, nevertheless, much of the terrestrial water resides underground. The terrestrial hydrological cycle, including its subsurface components was beautifully illustrated by a demonstration model (a miniature hillslope and river valley with forests, pastures and crop lands) built and brought to Vienna by the Leibniz Centre for Agricultural Landscape Research in Müncheberg, Germany. In the model one could trace water raining down on 'the face of the Earth' as it infiltrated the soil, moved back to the atmosphere through plant root, stems and leaves, or percolated further downwards to reach the groundwater where it slowly flowed horizontally towards a river. Even a drinking water well was represented, illustrating the importance of groundwater as a source of high-quality drinking water.

The model illustrated many but not all facets of the Hydrological Sciences. These are impossible to cover by a single individual. The HS Division therefore has ten subdivisions, each headed by a subdivision chair who is responsible for the programme for the corresponding segment of hydrology. These men and women spend a lot of their free time shaping the programme but are less visible to many attendants than the convenors or the division president, and for that reason I would like to highlight their importance for generating the scientific backbone of the General Assembly experience.

The various disciplines in hydrology are looking to the future, and the start of 2013–2022 Hydrological Decade, initiated by the International Association of Hydrological Sciences was marked by a dedicated session entitled 'Panta Rhei: a vision and an agenda for the next 10 years of hydrological research in support of society'. The following is a report by the current Chair of Panta Rhei, Alberto Montanari, who proposed and organised the session.

"Panta Rhei is dedicated to research activities on change in hydrology and society. The purpose of Panta Rhei is to reach an improved interpretation of the processes governing the water cycle by focusing on their changing dynamics in connection with rapidly changing human systems. The practical aim of Panta Rhei is to improve our capability to make predictions of water-resource dynamics to support sustainable societal development in a changing environment. The concept implies a focus on the hydrological system as a changing interface between environment and society, whose dynamics

Model of the terrestrial hydrological cycle at the EGU 2014 General Assembly, by the Leibniz Centre for Agricultural Landscape Research. (Credit:Stephanie McClellan/EGU)

are essential to determine water security, human safety and development, and to set priorities for environmental management.

The session was very well attended and included six carefully selected speakers covering the breadth of hydrology: Hubert Savenije, Demetris Koutsoyiannis, Upmanu Lall, Berit Arheimer, Efi Foufoula-Georgiou, and Stefania Tamea. Their presentations were insightful and triggered vigorous discussions after each talk that the chairmen could hardly stop. The powerpoint slides of each talk can be downloaded from the Panta Rhei web site (www.iahs.info/pantarhei). The visionary session definitely contributed to set the basis for future research activities to address societal challenges related to water."

Gerrit de Rooij
HS Division President

NP Nonlinear Processes in Geosciences

Thanks to all your efforts, the Nonlinear Processes (NP) Division had a good year: the 2014 General Assembly featured 416 NP abstracts (a 10% increase from 2013) in 22 NP sessions with 7 more sessions co-organised with other divisions. In addition, two NP short courses were organised: 'Scale, scaling and multifractals in complex geosystems' by S. Lovejoy and D. Schertzer, and 'Complex systems methods for data analysis and modelling in geosciences' by R. Donner and J. Donges. NP notably benefited fom an exceptionally high success rate (52%) for General Assembly travel grants. The conference also honoured NP's Outstanding Student Poster awardee Hyeyum Hailey Shind, and the recipient of the 2014 Lewis Fry Richardson Medal, Olivier Talagrand.

I would like to especially recognise the help of the science officers (Stefano Pierini, François Schmitt, Reik Donner, Olivier Talagrand, Jose Redondo, Philippe Fraunie, Valerio Lucarini), and other

members of the NP executive Daniel Schertzer (Publications), Isabel de Lima (Scientific Affairs), Henk Djikstra (Division Affairs) August Gires (Webmaster and new Young Scientist Representative), Catherine Nicolis (Richardson Award Committee), Gaci Said (Developing Countries Programme).

This was the first year that the Assembly had an official theme: The Face of the Earth. Although this theme certainly had some NP relevance, next year's theme, A Voyage Through Scales, was proposed by the NP division, and I hope will allow for direct NP involvement in the organisation of special activities. Although it is not yet clear exactly what this will entail, possibilities include theme-inspired exhibits, books and documentary films.

I'm looking forward to seeing you all in Vienna in 2015!

Shaun Lovejoy
NP Division President

OS Ocean Sciences

As the Ocean Sciences (OS) Division President Peter Brandt was unable to attend the 2014 General Assembly because of a research cruise, he asked me to represent the division during the conference. I have attended several assemblies in the past, as a participant prior to 2008, as convener since 2008, and as OS division officer since 2009. I was confirmed as the OS deputy president at the division business meeting during the conference.

The OS programme at the EGU 2014 General Assembly included over 250 oral and nearly 600 poster presentations. A highlight was surely the lecture of the Fridtjof Nansen medallist Stephen Griffies, who presented a lively overview of advances in the modelling of ocean circulation and processes, illustrated with stunning computer animations. In 2013 we started with the PICO presentations, which combine short oral presentations with in-depth discussion using large touch-screen displays. Unfortunately, in 2014, we could not convince our conveners to opt for such a session. Nonetheless, we will continue to promote this type of presentations, as they represent a stimulating way for scientific discussions and direct interactions among scientists.

At this point I want to thank the whole OS Division team, including the Nansen Medal committee who contributed significantly to the development of the division and also helped me in my functions during the Assembly. Special thanks go to former OS Division President Bernard Barnier, whose solid presence during the meeting was a great help.

One of the main pillars of the activities of the division is the open access Ocean Science journal. During the last few years, the number of submitted abstracts and accepted papers increased considerably; this is visible in the increased impact of this publication among the scientific community. Submissions peaked in 2012 owing to a large number of special issues and have plateaued in 2013. This success can be traced back to the great work of the team

Ocean Science is one of EGU's 16 open access journals.

of editors and reviewers, who have contributed to make the journal more and more attractive for readers and authors.

With the General Assembly, the Ocean Science journal, and the outreach and education activities, OS aims to further develop into a productive environment for scientists from Europe and all over the world to gain progress in the various ocean science disciplines and have beneficial interactions with other fields of the geosciences. It provides the platform for, in particular, young scientists to present their results, to network within the research community, and to play an active role in developing the future of the EGU and its Ocean Sciences Division.

On behalf of the OS Division President Peter Brandt,

Johan van der Molen
OS Division Deputy President

PS Planetary and Solar System Sciences

At the EGU 2014 General Assembly, the Planetary and Solar System Sciences (PS) Division had more than 750 abstracts in the programme, distributed over 24 sessions including co-organised sessions. There were 14 PS-led sessions with 420 submitted abstracts, representing roughly a 10% increase with respect to 2013. In 2014, oral and poster presentation constituted about 40% and 53%, respectively, of the total presentations, with the remaining 7% provided by the three PS PICO sessions, which generally received very positive feedback. The most popular PS-led sessions were related

to Mars science and exploration, and to outer planets, icy satellites and rings.

During the EGU 2014, the PS Division 2014 David Bates Medal was awarded to François Forget for his leadership in planetary climate modelling, his contributions to improving global climate models and for establishing the first quantitative framework for comparative planetology. The 2014 Division Outstanding Young Scientists Award was awarded to Christina Plainaki for fundamental studies on cosmic ray physics and on the interaction of icy moons surfaces with planetary magnetospheres. Congratulations to the awardees!

Several press conferences took place during the EGU 2014 promoting the diversity of planetary sciences. These included 'Fingerprints of life: from the early Earth to outer space' on habitability, 'The new face of the moon: science and exploration' on lunar exploration, 'Cassini and Saturn: the 10th anniversary and new results' on Saturn exploration, and 'Sights and sounds: volcanoes on Earth and mars', which included a presentation about supervolcanoes on Mars.

This year's General Assembly theme was The Face of the Earth. As part of the theme, the EGU organised an exhibit on the topic Space and the Earth with focus on comparative planetology. Jim Head from Brown University delivered the Face of the Earth Keynote Lecture on Space and the Earth. This exceptional lecture, as well as the press conferences, are available on demand after the conference. Next year's General Assembly theme will be A Voyage Through Scales, which, again, can prove very interesting for the PS community.

During the EGU 2014, a number of young scientists from the PS division volunteered to help at different domains including the programme, publications and outreach activities. Thanks to their initiatives it is now possible to follow the news and updates from the EGU

Space and the Earth exhibition area at the EGU 2014 General Assembly (Credit: Stephanie McClellan/EGU)

PS Division on Twitter and Facebook. They will also contribute in organising several short courses aimed for young scientists at next year's General Assembly. Future contributions from early-career researchers will also be greatly appreciated.

The preparation of the next EGU Assembly has already started with the announcement of the skeleton programme based on this year's successful sessions. All scientists, young and less young, are encouraged to be active within the PS Division. We are looking forward to receiving your proposals and suggestions to make the next General Assembly in Vienna another successful gathering.

Özgür Karatekin
PS Division President

EGU journal news: new impact factors, h5-index and an anniversary

EGU journals now display the most recent Thomson Reuters Impact Factors (IFs), which were published on 29 July in Journal Citation Reports. Earth System Dynamics received its first impact factor (IF 2.771), while publications such as Geoscientific Model Development (IF 6.086), The Cryosphere (IF 4.374) and Solid Earth (IF 2.155), significantly improved their impact in the past year. Three of EGU's journals (Geoscientific Model Development, Atmospheric Chemistry and Physics, and The Cryosphere) are now in the top 20 of journals in geoscience.

Our publisher Copernicus has also recently included the new Google Scholar Metrics h5-index, released at the end of June 2014, on the EGU journal pages. The index is based on citations from all articles indexed with Google Scholar as of mid-June 2013 and covers papers published between 2009 and 2013. According to this metric, Atmospheric Chemistry and Physics is the top journal in atmospheric sciences with an h5-index of 89. Other EGU journals, such as Hydrology and Earth System Sciences (h5-index 39) and Climate of the Past (h5-index 33), are also in the top 20 of their respective categories.

Finally, a quick note to mark the 10th anniversary of Biogeosciences, which had its first paper published in August 2004. Congratulations! For further information, check the announcement on the journal website.

A few of EGU's publications

We are grateful to all authors, reviewers and editors of EGU's open access journals for their invaluable help in increasing the impact of EGU publications and making them a success.

An earlier version of this article was published on the EGU website.

EGU 2015 General Assembly: call for sessions

The call for session proposals for the EGU 2015 General Assembly is now open. This is your opportunity to take an active part in organising the scientific programme of the conference!

Until 12 September you can suggest new sessions with conveners and description, or you can propose modifications to current ones. On the EGU 2015 General Assembly website, you can explore the skeleton programme when making suggestions. Study those sessions that already exist and put your proposal into the programme group that is most closely aligned with the proposed session's subject area. For further information, please check the online call for sessions at http://www.egu2015.eu/.

The next EGU General Assembly is taking place in Vienna, Austria from 12 to 17 April 2015. The abstract deadline is 7 January.

An earlier version of this article was published on the EGU 2015 website.

BACK TO CONTENTS

New communications officer at the EGU

Laura Roberts Artal, a Spanish and British national, is the newest member of EGU's communications team. She will manage GeoLog and the EGU blog network, run the Union's social media channels, and continue developing EGU's networking activities for young scientists. She'll be working closely with the EGU Media and Communications Manager, Bárbara Ferreira, at the EGU Executive Office in Munich, Germany.

Laura completed an undergraduate masters in geology at the University of Liverpool, where she investigated how and why magma/water interactions lead to typically explosive eruptions. Once she graduated, she spent three years in industry as an environmental consultant working on land contamination issues, before returning to Liverpool University to undertake a PhD researching whether the Earth had a magnetic field during the Archean, 3.5 billion years ago.

During her PhD, Laura has become an advocate for science outreach and communication. This has led her to regularly volunteer for the STEM (Science, Technology, Engineering and Mathematics) Ambassador Network and Science Grrl at outreach and public engagement events across the UK. She has designed and developed interactive activities for children and adults alike to raise the profile of Earth sciences amongst the general public. Laura has also been conducting communications activities within the EGU network, as one of the contributors to the Geology Jenga network blog. Laura says: "I am extremely excited by this new challenge and looking forward to spreading the word about all things Earth science via the EGU blog and the wide variety of social media platforms that EGU has a presence in." You can find Laura on Twitter (@LauRob85), or you can drop her an email at roberts@egu.eu if you have any questions.

The new EGU Communications Officer, Laura Roberts Artal.

The EGU is very grateful to Sara Mynott, former EGU Communications Officer, for the excellent work she developed while working for us. We wish her all the best in her marine biology PhD at the University of Exeter.

An earlier version of this article was published on the EGU blog.

Open geoscience

In a post on the EGU blog, GeoLog, former EGU Communications Officer Sara Mynott explores ways in which geoscientists can make their research more widely accessible.

Not so long ago I was in a meeting with EGU's young scientist representatives, who had gathered online to discuss the issues facing those early in their academic careers. One member of this dedicated team put forward a compelling notion: that the future of open access is in the hands of today's early-career researchers. This post aims to answer the question that followed: "how could EGU's team of eager early-career researchers help their peers grab hold of the open opportunities out there?" By offering up a few routes to open science…

A lot of hard work, carefully created **figures** and data don't make it to your publications, but they are still a useful part of the scientific process and can help other scientists if they can see what you found. A great way to share this sort of information is on Figshare – and it's citable too.

Free the work from your desktop folders. (Credit: opensource.com)

The same goes for conference **presentations** – don't let them gather dust on your desktop. The aim of a conference is to share your work more widely, so, when you're done, put your slides up on sites like SlideShare to share it beyond the conference. Keep your contact details in the presentation and you could find yourself with new collaborators.

BACK TO CONTENTS

Don't let your work gather dust, share it. (Credit: How Matters)

Posters can be made open too. After our annual General Assembly, we invite authors to upload their posters and presentations, but there's no need to restrict your openness to the EGU conference. F1000 posters is an open access repository for posters in biology, so if your work bridges the biogeosciences, be sure to submit it there. If you're in another field, try Figshare (despite the name, it's not just for figures!).

The EGU offers a number of open access journals for the Earth, planetary and space sciences, but there are many more **journals** where you can publish your work, if the scope of EGU journals doesn't quite cover your field. The American Geosciences Institute hosts a comprehensive list of open geo journals on their website, and the Directory of Open Access Journals is exactly what it says on the tin – a hub of high quality open access publications. The stringent criteria required to enter their database means that predatory open access journals are filtered out.

But what about **impact**? Going open doesn't mean lower impact, in fact, with your paper being openly available to all, it's more likely to be seen and cited, so the impact at the article level could well be higher than if it was in a subscription-based publication. You can track the impact of your research outputs using ImpactStory, or by using the Altmetric bookmarklet to keep tabs on more than just citations, from where it's featured in news articles and blog posts to where it's been mentioned on social media and more.

The European Research Council considers that providing free online access to publications is the most effective way of ensuring that the fruits of the research it funds can be accessed, read and used as the basis for further research. Many **funders** are also moving in this direction, providing further incentive to publish open access papers.

When your manuscript is ready, submit it to a **preprint** server (e.g., arxiv.org, peerj.com, or biorxiv.org). EGU papers have an open review process, which helps ensure the assessment of a submitted manuscript is thorough and fair, but it also means that the science is out in the open sooner – the merit of a preprint. This helps establish precedence, highlighting that you were working on something first, and can remove barriers to scientific progress (we all know peer review can take a while!). Some establishments aren't a fan of this though; so before you put a preprint online, check Sherpa/Romeo to make sure your institute, funding body and the journal(s) you're interested in are on board with the benefits of preprints.

Models are near ubiquitous in the geosciences and their importance in assessing the impact of climate change goes without saying. But what if you couldn't replicate the results of, say, an important climate model? You would need to go back to the model's **code** and see where your calculations and the ones before differed. Sharing code is compulsory for journals like Geoscientific Model Development, but many don't stipulate the need to share it. You can go one step further to help your community by sharing your code on GitHub, whether it's compulsory for your latest article or not.

With all these opportunities to go open, wouldn't it be great if you had an opportunity to keep track of all your outputs? There's an answer for that too – ORCID. ORCID is a **unique researcher identifier** that links all your research outputs, from manuscripts and conference abstracts to grant submissions and research figures, ensuring you get credit for the work you do.

For something less formal, but perhaps more open in that you can go beyond the academic community, try **blogging** about your research – we readily welcome guest posts on GeoLog, but there are many places you can set your science free. Try The Conversation, SciLogs, pitching your idea to another geoscience blogger or better yet, establishing your own blog to write on. You can also go further to promote your research and facts about your field on **social media** – a great way to form connections with other academics and put your work in the public eye.

These are just a few thoughts on open geoscience, but there are likely more ways to go open than could ever be summarised in a single post. Take this is a starting point, seek out more options for yourself, and, if you already have a few tips on how to make geoscience more open, spread the word.

Sara Mynott

Former EGU Communications Officer (from September: PhD student in marine biology at the University of Exeter)

This article was previously published on the EGU blog.

From Finding Nemo to minerals – what riches lie in the deep sea?

EGU press release on research published in Biogeosciences

As fishing and the harvesting of metals, gas and oil have expanded deeper and deeper into the ocean, scientists are drawing attention to the services provided by the deep sea, the world's largest environment. "This is the time to discuss deep-sea stewardship before exploitation is too much farther underway," says lead-author Andrew Thurber. In a review published in Biogeosciences, an EGU journal, Thurber and colleagues summarise what this habitat provides to humans, and emphasise the need to protect it.

"The deep sea realm is so distant, but affects us in so many ways. That's where the passion lies: to tell everyone what's down there and that we still have a lot to explore," says co-author Jeroen Ingels of Plymouth Marine Laboratory in the UK.

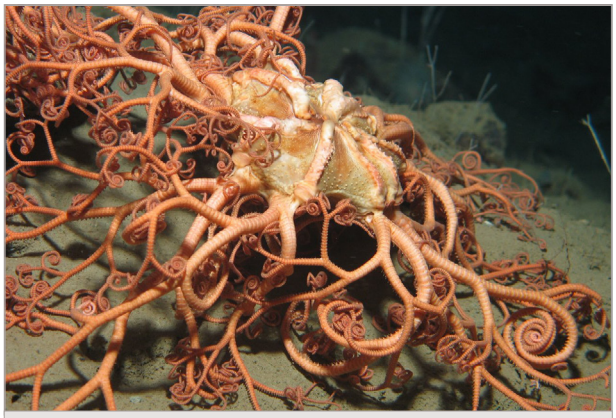
"What we know highlights that it provides much directly to society," says Thurber, a researcher at the College of Earth, Ocean and Atmospheric Sciences at Oregon State University in the US. Yet, the deep sea is facing impacts from climate change and, as resources are depleted elsewhere, is being increasingly exploited by humans for food, energy and metals like gold and silver.

"We felt we had to do something," says Ingels. "We all felt passionate about placing the deep sea in a relevant context and found that there was little out there aimed at explaining what the deep sea does for us to a broad audience that includes scientists, the non-specialists and ultimately the policymakers. There was a gap to be filled. So we said: 'Let's just make this happen'."

In the review of over 200 scientific papers, the international team of researchers points out how vital the deep sea is to support our current way of life. It nurtures fish stocks, serves as a dumping ground for our waste, and is a massive reserve of oil, gas, precious metals and the rare minerals we use in modern electronics, such as cell phones and hybrid-car batteries. Further, hydrothermal vents and other deep-sea environments host life forms, from bacteria to sponges, that are a source of new antibiotics and anti-cancer chemicals. It also has a cultural value, with its strange species and untouched habitats inspiring books and films from 20,000 Leagues Under the Sea to Finding Nemo.

"From jewellery to oil and gas and future potential energy reserves as well as novel pharmaceuticals, deep-sea's worth should be recognised so that, as we decide how to use it more in the future, we do not inhibit or lose the services that it already provides," says Thurber.

The deep sea (ocean areas deeper than 200 m) represents 98.5% of the volume of our planet that is hospitable to animals. It has



Gorgonocephalus caputmedusae (pictured) was the first species ever recovered from the deep sea. (Credit: SERPENT Project/D.O.B. Jones)

received less attention than other environments because it is vast, dark and remote, and much of it is inaccessible to humans. But it has important global functions. In the Biogeosciences review the team shows that deep-sea marine life plays a crucial role in absorbing carbon dioxide from the atmosphere, as well as methane that occasionally leaks from under the seafloor. In doing so, the deep ocean has limited much of the effects of climate change.

This type of process occurs over a vast area and at a slow rate. Thurber gives other examples: manganese nodules, deep-sea sources of nickel, copper, cobalt and rare earth minerals, take centuries or longer to form and are not renewable. Likewise, slow-growing and long-lived species of fish and coral in the deep sea are more susceptible to overfishing. "This means that a different approach needs to be taken as we start harvesting the resources within it."

By highlighting the importance of the deep sea and identifying the traits that differentiate this environment from others, the researchers hope to provide the tools for effective and sustainable management of this habitat.

"This study is one of the steps in making sure that the benefits of the deep sea are understood by those who are trying to, or beginning to, regulate its resources," concludes Thurber. "We ultimately hope that it will be a useful tool for policymakers."

This press release was originally published on the EGU website.

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BACK TO CONTENTS

Has Antarctic sea ice expansion been overestimated?

EGU press release on research published in The Cryosphere

New research suggests that Antarctic sea ice may not be expanding as fast as previously thought. A team of scientists say much of the increase measured for Southern Hemisphere sea ice could be due to a processing error in the satellite data. The findings are published in The Cryosphere, a journal of the European Geosciences Union (EGU).

Tabular iceberg surrounded by sea ice in the Antarctic. (Credit: Eva Nowatzki, distributed via imaggeo.egu.eu)

Arctic sea ice is retreating at a dramatic rate. In contrast, satellite observations suggest that sea ice cover in the Antarctic is expanding – albeit at a moderate rate – and that sea ice extent has reached record highs in recent years. What's causing Southern Hemisphere sea ice cover to increase in a warming world has puzzled scientists since the trend was first spotted. Now, a team of researchers has suggested that much of the measured expansion may be due to an error, not previously documented, in the way satellite data was processed.

"This implies that the Antarctic sea ice trends reported in the IPCC's AR4 and AR5 [the 2007 and 2013 assessment reports from the Intergovernmental Panel on Climate Change] can't both be correct: our findings show that the data used in one of the reports contains a significant error. But we have not yet been able to identify which one contains the error," says lead-author Ian Eisenman of the Scripps Institution of Oceanography at University of California San Diego in the US.

Reflecting the scientific literature at the time, the AR4 reported that Antarctic sea ice cover remained more or less constant between 1979 and 2005. On the other hand, recent literature and the AR5 indicate that, between 1979 and 2012, Southern Hemisphere sea ice extent increased at a rate of about 16.5 thousand square kilometres per year. Scientists assumed the difference to be a result of adding several more years to the observational record.

"But when we looked at how the numbers reported for the trend had changed, and we looked at the time series of Antarctic sea ice extent, it didn't look right," says Eisenman, who set out to figure out what was wrong.

Scientists have used satellite data to measure sea ice cover for 35 years. But the data doesn't come from a single instrument, orbiting on a single satellite throughout this period. Instead, researchers splice together observations from different instruments flown on a number of different satellites. They then use an algorithm – the most prevalent being the Bootstrap algorithm – and further processing to estimate sea ice cover from these data.

In the study published in The Cryosphere, Eisenman and collaborators compare two datasets for sea ice measurements. The most recent one, the source of AR5 conclusions, was generated using a version of Bootstrap updated in 2007, while the other, used in AR4 research, is the result of an older version of the algorithm.

The researchers found a difference between the two datasets related to a transition in satellite sensors in December 1991, and the way the data collected by the two instruments was calibrated. "It appears that one of the records did this calibration incorrectly, introducing a step-like change in December 1991 that was big enough to have a large influence on the long-term trend," explains Eisenman.

"You'd think it would be easy to see which record has this spurious jump in December 1991, but there's so much natural variability in the record – so much 'noise' from one month to the next – that it's not readily apparent which record contains the jump. When we subtract one record from the other, though, we remove most of this noise, and the step-like change in December 1991 becomes very clear."

With the exception of the longer time period covered by the most recent dataset, the two records were thought to be nearly identical. But, by comparing the datasets and calculating Antarctic sea ice extent for each of them, the team found that there was a stark difference between the two records, with the current one giving larger rates of sea ice expansion than the old one in any given period.

If the error is in the current dataset, the results could contribute to an unexpected resolution for the Antarctic sea ice cover enigma.

This press release was originally published on the EGU website.

References

Eisenman, I., Meier, W. N., and Norris, J. R.: A spurious jump in the satellite record: has Antarctic sea ice expansion been overestimated?, The Cryosphere, 8, 1289–1296, 2014

Atmospheric Chemistry and Physics (ACP)

Global emission projections for the transportation sector using dynamic technology modelling

In this study, global emissions of gases and particles from the transportation sector are projected from the year 2010 to 2050. The Speciated Pollutant Emission Wizard (SPEW)-Trend model, a dynamic model that links the emitter population to its emission characteristics, is used to project emissions from on-road vehicles and non-road engines.

Reference

Yan, F. et al.: Global emission projections for the transportation sector using dynamic technology modelling, Atmos. Chem. Phys., 14, 5709–5733, 2014

Nighttime observation and chemistry of HO_x in the Pearl River Delta and Beijing in summer 2006

Nighttime HO_x chemistry was investigated in two ground-based field campaigns in summer 2006 in China by comparing measured and modelled concentration data of OH and HO_2. The measurement sites were located in a rural environment in the Pearl River Delta under urban influence and in a suburban area close to Beijing, respectively.

Reference

Lu, K. D. et al..: Nighttime observation and chemistry of HO_x in the Pearl River Delta and Beijing in summer 2006, Atmos. Chem. Phys., 14, 4979–4999, 2014

Atmospheric Measurement Techniques (AMT)

EARLINET: towards an advanced sustainable European aerosol lidar network

This paper gives an overview of the European Aerosol Research Lidar Network (EARLINET) main developments since 2000 and introduces the dedicated EARLINET special issue. This issue reports on the present innovative and comprehensive technical solutions and scientific results related to the use of advanced lidar remote sensing techniques for the study of aerosol properties as developed within the network in the last 13 years.

References

Pappalardo, G. et al.: EARLINET: towards an advanced sustainable European aerosol lidar network, Atmos. Meas. Tech., 7, 2389–2409, 2014

AMT Special Issue: EARLINET, the European Aerosol Research Lidar Network, Editor(s): G. Pappalardo, A. Ansmann, R. Ferrare, and N. Sugimoto

Past changes in the vertical distribution of ozone – Part 1: Measurement techniques, uncertainties and availability

This paper presents an overview of stratospheric ozone profile measurement data sets (ground and satellite based) available for ozone recovery studies. It documents measurement techniques, spatial and temporal coverage, vertical resolution, native units and measurement uncertainties. In addition, the latest data versions are briefly described (including data version updates as well as detailing multiple retrievals when available for a given satellite instrument). Archive location information for each data set is also given.

Reference

Hassler, B. et al.: Past changes in the vertical distribution of ozone – Part 1: Measurement techniques, uncertainties and availability, Atmos. Meas. Tech., 7, 1395–1427, 2014

BACK TO CONTENTS

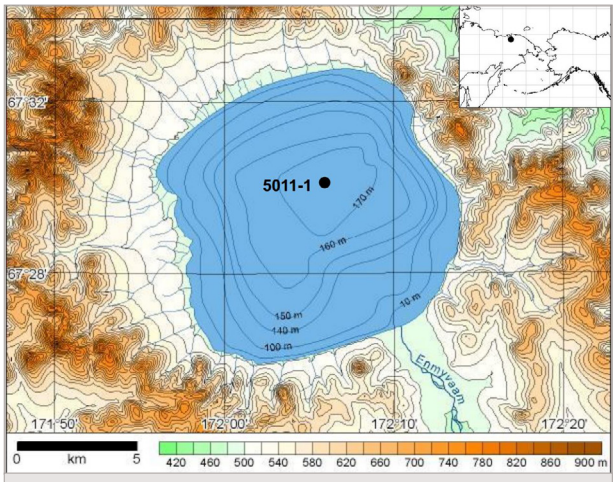
Climate of the Past (CP)

Late Pliocene and Early Pleistocene vegetation history of northeastern Russian Arctic inferred from the Lake El'gygytgyn pollen record

The 318 m thick lacustrine sediment record from Lake El'gygytgyn, northeastern Russian Arctic cored by the international El'gygytgyn Drilling Project provides unique opportunities for the time-continuous reconstruction of the regional palaeoenvironmental history for the past 3.6 Myr. This paper presents an analysis of this record.

Reference

Andreev, A. A. et al.: Late Pliocene and Early Pleistocene vegetation history of northeastern Russian Arctic inferred from the Lake El'gygytgyn pollen record, Clim. Past, 10, 1017–1039, 2014



Location of map Lake El'gygytgyn in northeastern Russia (inserted map) with location of the core site (Credit: Andreev et al., 2014)

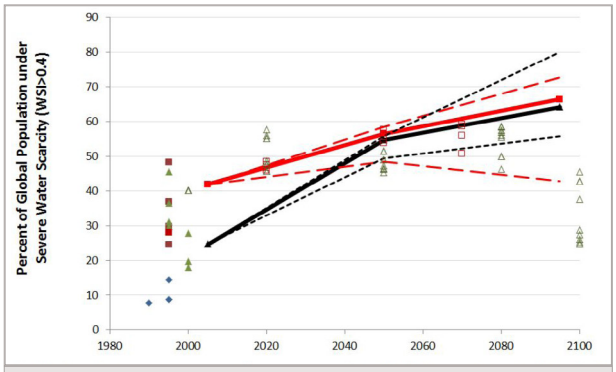
Hydrology and Earth System Sciences (HESS)

Integrated assessment of global water scarcity over the 21st century under multiple climate change mitigation policies

Water scarcity conditions over the 21st century both globally and regionally are assessed in the context of climate change and climate mitigation policies, by estimating both water availability and water demand within the Global Change Assessment Model, a leading community-integrated assessment model of energy, agriculture, climate and water.

Reference

Hejazi, M. I. et al.: Integrated assessment of global water scarcity over the 21st century under multiple climate change mitigation policies, Hydrol. Earth Syst. Sci., 18, 2859–2883, 2014



Comparison of the estimated percent of global population under severe water stress in grid cells (black lines) and basin areas (red lines) along with previous estimates from the literature. (Credit and further information: Hejazi et al., 2014)

Impact of modellers' decisions on hydrological a priori predictions

Researchers report the discharge predictions of 10 modellers – using the model of their choice – for the man-made Chicken Creek catchment (6 ha, northeast Germany) and analyse how well they improved their prediction in three steps based on adding information prior to each following step.

Reference

Holländer, H. M. et al.: Impact of modellers' decisions on hydrological a priori predictions, Hydrol. Earth Syst. Sci., 18, 2065–2085, 2014

Joint Editorial: On the future of journal publications in hydrology

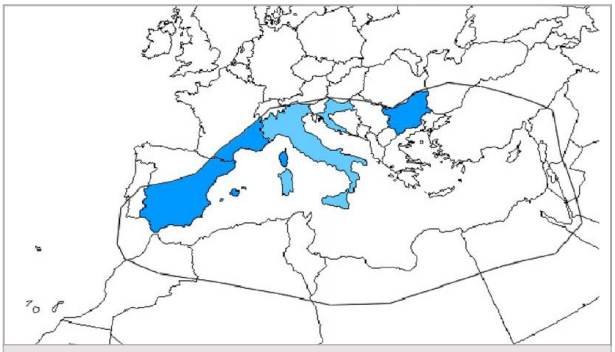
In this joint editorial, a group of editors from hydrology journals discuss a number of actions to help strengthen publications and research in hydrology as a whole.

Reference

Blöschl, G. et al.: Joint Editorial 'On the future of journal publications in hydrology', Hydrol. Earth Syst. Sci., 18, 2433–2435, 2014

BACK TO CONTENTS

Natural Hazards and Earth System Sciences (NHESS)



Zones with data in the calendar of high impact weather events included in the MEDEX database. Dark blue corresponds to areas with high density of stations and light blue to zones with low density of stations. (Credit: Jansa et al., 2014)

MEDEX: a general overview

The general objective of the international MEDiterranean EXperiment (MEDEX) was to better understand and forecast cyclones that produce high-impact weather in the Mediterranean. This paper reviews the motivation and foundation of MEDEX, the gestation, history and organisation of the project, as well as the main products and scientific achievements obtained from it.

Reference

Jansa, A. et al.: MEDEX: a general overview, Nat. Hazards Earth Syst. Sci., 14, 1965–1984, 2014

Ocean Science (OS)

Weighing the ocean with bottom-pressure sensors: robustness of the ocean mass annual cycle estimate

A team of researchers used ocean bottom-pressure measurements from 17 tropical sites to determine the annual cycle of ocean mass. In this paper they show that such a calculation is robust, and use three methods to estimate errors in the mass determination.

Reference

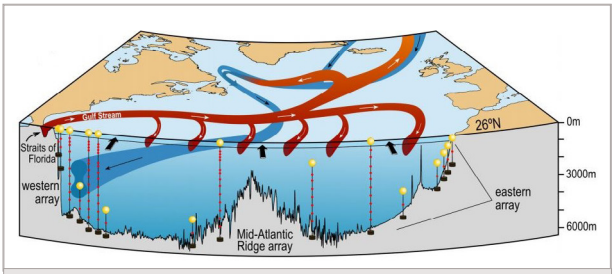
Williams, J. et al.: Weighing the ocean with bottom-pressure sensors: robustness of the ocean mass annual cycle estimate, Ocean Sci., 10, 701–718, 2014

Impact of a 30% reduction in Atlantic meridional overturning during 2009–2010

The Atlantic meridional overturning circulation comprises warm upper waters flowing northward, becoming colder and denser until they form deep waters in the Labrador and Nordic Seas that then return southward through the North and South Atlantic. A team has been monitoring the circulation at 25° N since 2004 and report on the results in this paper.

Reference

Bryden, H. L. et al.: Impact of a 30% reduction in Atlantic meridional overturning during 2009–2010, Ocean Sci., 10, 683–691, 2014



Schematic of Rapid monitoring system for the Atlantic meridional overturning circulation (AMOC) at 26 degrees N. (Credit: Bryden et al., 2014)

Sources of 21st century regional sea-level rise along the coast of northwest Europe

There are various contributions to sea level rise, including effects in the solid Earth, gravity field, changes in ocean mass due to ice loss from ice sheets and glaciers, thermal expansion, alterations in ocean circulation driven by climate change and changing freshwater fluxes, and the intensity of storm surges. Focusing on the coastline of northwest Europe, the authors consider these processes and their relative impact on 21st century regional mean sea levels and the 50-year return flood height.

Reference

Howard, T. et al.: Sources of 21st century regional sea-level rise along the coast of northwest Europe, Ocean Sci., 10, 473–483, 2014

Solid Earth (SE)

Physicochemical changes in pyrogenic organic matter (biochar) after 15 months of field ageing

Predicting the effects of pyrogenic organic matter (OM) addition (either natural or intentional as in the case of biochar amendment) on soil chemistry and crop yields has been hampered by a lack of understanding of how pyrogenic OM evolves in the environment over time. This work compared the physicochemical characteristics of newly made and 15-month-field-aged biochars and biochar–soil mixtures.

Reference

Mukherjee, A. et al.: Physicochemical changes in pyrogenic organic matter (biochar) after 15 months of field aging, Solid Earth, 5, 693–704, 2014

Crop residue decomposition in Minnesota biochar-amended plots

Impacts of biochar application at laboratory scales are routinely studied, but impacts of biochar application on decomposition of crop residues at field scales have not been widely addressed. The priming or hindrance of crop residue decomposition could have a cascading impact on soil processes, particularly those influencing nutrient availability. The aim of this paper is to evaluate biochar effects on field decomposition of crop residue, using plots that were amended with biochars made from different plant-based feedstocks and pyrolysis platforms in the fall of 2008.

Reference

Weyers, S. L. and Spokas, K. A.: Crop residue decomposition in Minnesota biochar-amended plots, Solid Earth, 5, 499–507, 2014

The Cryosphere (TC)

Ice-ocean interaction and calving front morphology at two west Greenland tidewater outlet glaciers

In this paper, researchers present a suite of fjord salinity, temperature, turbidity versus depth casts along with glacial runoff estimation from Rink and Store glaciers, two major marine outlets draining the western sector of the Greenland Ice Sheet during 2009 and 2010. They characterise the main water bodies present and interpret their interaction with their respective calving fronts.

Reference

Chauché, N. et al.: Ice-ocean interaction and calving front morphology at two west Greenland tidewater outlet glaciers, The Cryosphere, 8, 1457–1468, 2014

A high-resolution bedrock map for the Antarctic Peninsula

Assessing and projecting the dynamic response of glaciers on the Antarctic Peninsula to changed atmospheric and oceanic forcing requires high-resolution ice thickness data as an essential geometric constraint for ice flow models. In this study, researchers derive a complete bedrock data set for the Antarctic Peninsula north of 70° S on a 100 m grid.

Reference

Huss, M. and Farinotti, D.: A high-resolution bedrock map for the Antarctic Peninsula, The Cryosphere, 8, 1261–1273, 2014

Modelled Arctic sea ice evolution through 2300 in CMIP5 extended RCPs

Extended representative concentration pathway simulations through 2300 were completed for a subset of models. In this study, researchers examine the time evolution of Arctic sea ice in these simulations.

Reference

Hezel, P. J., Fichefet, T., and Massonnet, F.: Modelled Arctic sea ice evolution through 2300 in CMIP5 extended RCPs, The Cryosphere, 8, 1195–1204, 2014

The sub-ice platelet layer and its influence on freeboard to thickness conversion of Antarctic sea ice

This paper reports on an investigation to quantify the influence of the sub-ice platelet layer on satellite measurements of total freeboard and their conversion to thickness of Antarctic sea ice.

Reference

Price, D. et al.: The sub-ice platelet layer and its influence on freeboard to thickness conversion of Antarctic sea ice, The Cryosphere, 8, 1031–1039, 2014

BACK TO CONTENTS

ARTICLES
EGU VOICE
EGU NEWS
PRESS RELEASES
JOURNAL WATCH
EXTERNAL NEWS
EDUCATION
YOUNG SCIENTISTS
BOOKS
EVENTS

Earth scientists and Munich's Rachel Carson Center – bridging the two cultures?

Geoscientists Seth Stein and Anke Friedrich introduce the interdisciplinary Rachel Carson Center for Environment and Society.

In 1959, English chemist, civil servant, and novelist C. P. Snow argued in a famous lecture at Cambridge University that an intellectual gap existed between scientists and humanists, 'two cultures' who did not understand each other. The two cultures concept has since often been invoked as part of the challenge in addressing problems with both scientific and societal aspects.

Many important issues – including energy, resources, hazards, climate change – exemplify this problem. Natural processes like earthquakes, volcanoes and floods are hazardous to society because of our cultural choices about where and how we live. Anthropogenic climate change is a problem not because today's climate is 'better' than warmer or cooler climates of the past, but because changes would disrupt societies that are adapted to today's climate. Energy, transportation and land-use policies involve what we choose to do as much as what is technically possible.

Addressing such issues thus involves both cultures. For example, a seismologist could try to estimate how large an earthquake to expect on a fault near a city. An engineer would consider various ways to make buildings there more earthquake resistant, while an economist would try to balance resources spent for this purpose with the city's other needs. An anthropologist would ask how cultural perceptions of risk affect the community's view of different options, and a political scientist would consider how the community could reach informed consensus on a policy.

Historically, such issues bridged the two cultures. John Muir, founder of the Sierra Club, was an amateur scientist and early member of the Seismological Society of America. Today, however, as Snow noted, educational systems typically give members of each culture little appreciation of crucial concepts from the other. A seismologist may have little understanding of the costs and benefits involved in different hazard mitigation strategies. A political scientist may not appreciate the difference between the magnitude of an earthquake – a property of the event – and the resulting intensity of shaking that depends on the distance from the earthquake and the local geology.

Bridging such gaps between the cultures is difficult, in part because of the lack of clear ways to interact with and learn from each other. Each culture has well developed institutions, like EGU, for communicating within itself. However, each often knows little about corresponding institutions on the other side of the gap.

A small example of what can be done are interactions that are starting between Earth scientists and Munich's Rachel Carson Center for Environment and Society, an interdisciplinary center for research and education in the environmental humanities and social sciences. The RCC was founded in 2009 as a joint initiative of Munich's Ludwig-Maximilians-Universität (LMU) and the city's science museum, the Deutsches Museum, with support from the German Federal Ministry of Education and Research. It is directed by LMU professor Christof Mauch, a historian with an interest in international environmental history as well as nineteenth- and twentieth-century North American and German history, and Helmuth Trischler, head of research at the Deutsches Museum and professor of modern history and the history of technology at LMU.

The mission of the Rachel Carson Center for Environment and Society is "to advance research and discussion concerning the interaction between human agents and nature, and to strengthen the role of the humanities in current political and scientific debates about the environment."

The RCC seeks to advance research and discussion about the interaction between human agents and nature, and to strengthen the role of the humanities in current political and scientific debates about the environment. It supports and convenes an interdisciplinary and international group of scholars who study the complex relationship between nature and culture.

The RCC communicates research and advances the environmental humanities through a variety of activities:

- A writing fellowship programme
- A PhD programme in Environment and Society at LMU Munich
- International conferences and workshops
- The Environment & Society Portal, a digital humanities tool
- Book series in English and in German
- A free, online journal called RCC Perspectives
- Multiple exhibitions at the Deutsches Museum and other venues
- A blog, Seeing the Woods

Recently, we and other Earth scientists have started to use interactions with the RCC as a small bridge across the cultural gap. Anke

Anke Friedrich showing RCC students and colleagues rock samples derived from the Alps, illustrating how young glacial deposits record older tectonic events and how solid earth processes affect global climate. (Credit: RCC)

Seth Stein on field trip, discussing the challenge of distinguishing natural and anthropogenic global warming. (Credit: RCC)

Friedrich, Professor of Geology at LMU, is a faculty member of the RCC and participates in RCC programmes. This summer she led a field trip to an area south of Munich to introduce the RCC students to geological concepts including glacial deposits, the evolution of the Alps, and the relation between solid Earth processes and climate change.

Friedrich and Seth Stein from Northwestern University, who is visiting Germany as a recipient of an Alexander von Humboldt Foundation research award, taught a joint geology and RCC course 'Defending society against natural hazards in a very uncertain world.' This explored issues such as: How should a developing nation allocate its budget between building schools for towns without ones or making existing schools earthquake-resistant? Does it make more sense to build levees to protect against floods, or to prevent development in the areas at risk? Would more lives be saved by making hospitals earthquake-resistant, or using the funds for patient care? What should scientists tell the public when – as occurred in L'Aquila, Italy and Mammoth Lakes, California – there is a real but small risk of an upcoming earthquake or volcanic eruption?

RCC Fellow Mike Hulme, Professor of Climate and Culture from King's College London, is using his time in Munich to write a book exploring the idea of climate change using historical, cultural, and scientific analyses, seeking to illuminate the numerous ways in which climate change is deployed in public and political discourse. He and other RCC colleagues also organised a seminar on cultures of prediction in climate science.

In addition, we participate in some RCC activities, such as weekly seminars. These deal with topics including invasive species policy, societal issues in mass transportation, sustainable forestry, and the like. Discussions often deal with issues familiar to us, but from a different view. For example, how could society collectively decide to lower CO_2 emissions by choosing not to exploit existing fossil fuel reserves?

We hope that our interactions with the RCC students and other community members bring useful insights to them. Certainly it is true from our side: it is fun to interact with colleagues, especially bright and motivated students, who are interested in similar problems from a different view.

For example, on a field trip along the Isar river, we discussed river flooding and whether Germany should have a national natural hazard insurance programme. We and the geoscience students focused on the costs and the problem that public insurance subsidises development in dangerous places. In contrast, some RCC students focused on the government's ethical obligation to citizens and citizens' obligations to each other. Often RCC students raise important philosophical, cultural, class, and gender issues that would likely not occur to us.

Based on experiences like these, we think that Earth scientists have much to gain from trying to interact across the gap between the two cultures. Munich's Carson Center is an example of the kind of counterparts that make this much easier. After all, Rachel Carson was trained as a biochemist before becoming one of the 20th century's most influential environmental writers.

Seth Stein[1] and Anke M. Friedrich[2]

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[2]Earth and Environmental Sciences, LMU University of Munich,Germany; Affiliated LMU Professor, Rachel Carson Center (friedrich@lmu.de)

Our Changing Planet

A report on the 2014 GIFT workshop

This year the GIFT, Geosciences Information For Teachers, workshop united 84 teachers from 18 different countries around the general theme, Our Changing Planet.

The theme of the 2014 GIFT workshop was chosen on the occasion of the publication of the IPCC (Intergovernmental Panel on Climate Change) 5th Assessment Report on climate change. The EGU Committee on Education felt that this event, publicised worldwide, would attract much attention from secondary schools students, and therefore that it was important to provide the teachers with direct and timely information on the latest IPCC results.

The workshop took place from 27 to 30 April, at the EGU 2014 General Assembly, and started with a welcome from Günter Blöschl, the EGU President. Then, Thomas Stocker, Co-Chair of the IPCC Working Group I (The Physical Basis), took to the stage to discuss the main achievements of recent years in climate-change science, focusing on three main points: observations, understanding and future. Based on multiple lines of independent evidence from the atmosphere, the ocean and the cryosphere, the IPCC has concluded that warming in the climate system is unequivocal. Since 1951 the Earth has warmed by about 0.6 to 0.7 °C, which is one manifestation of a change in the energy balance of the Earth. Stocker explained that this arises from positive radiation forcing caused by the increase in the concentration of greenhouse gases and a smaller cooling contribution by the increase in aerosols. Therefore, it is *extremely likely* (this is the IPCC terminology) that more than half of the observed increase in global average surface temperature from 1951 to 2010 has been caused by anthropogenic factors.

Stocker also emphasised that a new and very important element of the latest IPCC assessment is the recognition of the almost linear relationship between the total cumulative emissions of CO_2 and the global mean surface warming of the late 21st century. This means that if we want to limit global warming to 2 °C with respect to the mid-19th century, the total amount of carbon emitted since then must be less than 790 billion tons. Of these, 535 billion tons have already been emitted, leaving us with 255 billion tons to be spent! At the present rate of emission of about 10 billion tons per year, that leaves us with about 25 years, beyond which – if no reduction in emissions is obtained – it will be impossible to meet the 2 °C warming target. This is one of the most important messages of the IPCC assessment to policymakers.

Thomas Blunier (University of Copenhagen) and Valérie Masson-Delmotte (Laboratoire des Sciences du Climat et de l'Environnement [LSCE], Gif-sur-Yvette) then explained how climate factors can be retrieved from ice cores in Greenland and Antarctica. After a presentation on the technical aspects of ice coring, Blunier focused on the reconstruction of past atmospheric composition based on the air bubbles contained in the ice. Masson-Delmotte explained how the study of different isotopic ratios allows researchers to reconstruct past variations in temperature.

Valérie Masson-Delmotte during her presentation. (Credit: Filippo Camerlenghi)

The informative lectures were followed by an afternoon dedicated to hands-on activities led by Sally Dengg (GEOMAR, Kiel) and Francesca Ugolini (Institute of Biometeorogy, Florence). The following day Francesco Sarti (ESA's European Space Research Institute, Frascati) explained how space observations can be used in monitoring changes of the Earth's global environment. A 'space view' was also used by Anny Cazenave (Laboratoire en Géophysique et Océanographie Spatiale, Toulouse) to obtain a precise estimate of very recent sea level rise, a threat to so many countries worldwide.

Hands-on activity on ocean acidification. (Credit: Filippo Camerlenghi)

Laurent Bopp (LSCE, Gif-sur-Yvette) addressed the problem of carbon exchanges between reservoirs involved in its global cycle and their changes over time. The major issues deal with understanding past variations of atmospheric CO_2 and estimating the evolution of atmospheric CO_2 in response to anthropogenic carbon emissions over the next decades and centuries.

The issue of how increased absorption of CO_2 by the ocean leads to ocean acidification and to major changes in the marine biosphere was addressed by James Orr (both at LSCE, Gif-sur-Yvette and International Atomic Energy Agency, Monaco).

Larry Mayer (University of New Hampshire) then described the recent changes in ice cover in the Arctic Ocean: between 1979 and 2012 the annual mean extent of the Arctic Ocean has decreased by about 4% per decade with the summer sea ice minimum decreasing between about 9 to 13%, and there is a steady loss of old, thick, multi-year ice, and the rate of loss is increasing. Projected in the future, these trends indicate that the Arctic Ocean may have a nearly ice free season by the middle of the century, with huge consequences for global climate.

The impact of climate change on agriculture has also been discussed by Bernard Seguin (Institute National de Recherches Agronomiques, Avignon). Observed changes in agriculture and livestock resulting from the recent warming are still hardly detectable, except for advances in phenology. But projections indicate that at low latitudes even moderate temperature increases are likely to have negative yield impacts for major cereals. Further warming has increasingly negative impacts in all regions.

Finally, Stephen Macko (University of Virginia) addressed a general conclusion with a talk on 'Implication of a changing Earth: obvious and cascading', which explored and summarised the very different aspects of climate change discussed during the GIFT workshop. Macko has showed how some aspects of climate change have a clear direct relationship to human activities, whilst others result from a cascading process, such an increase in the release of methane and an increase in global temperature.

Moreover, as in every GIFT workshop, a poster session, 'Science in tomorrow's classroom', was included in the programme. The work presented at the session was aimed at various educational levels, from schools to post-graduate education and beyond, and included 60 GIFT teacher presentations together with 15 university contributions on undergraduate, post-graduate and outreach pedagogy. The teachers presented their projects on field, laboratory and classroom work. They also discussed their activities with each other and took away new ideas for enhancing their teaching in the future. Each GIFT teacher received a certificate of participation in the recognition of their efforts, and they can use the EGU posters in their schools to show their pedagogy to students, other teachers and parents.

Phil Smith (educator at Teacher Scientist Network, Norwich, UK and member of the EGU Committee on Education) and Ana Sousa (teacher at Escola Secundária Domingos Rebelo, Açores, Portugal) discuss in front of Sousa's poster during the 'Science in tomorrow's classroom' poster session at the EGU 2014 General Assembly. (Credit: Miguel Nata)

In the two and a half days of the 2014 GIFT workshop we had time to describe and discuss the major aspects of the IPCC 5th Assessment Report. We feel confident that these presentations will help teachers in transmitting the major notions to their pupils (our ambassadors to the future!).

Eve Arnold, Carlo Laj and Stephen Macko
On behalf of the EGU Committee on Education

Science into policy: taking local steps for global change

Geoscience forms a strong foundation for environmental policy, and geoscientific research can have a major impact on the way we tackle climate change, mitigate natural hazards, manage natural resources and more. But, despite the wealth of policy-relevant findings made each year, getting research from the academic realm and into the political arena isn't always an easy process. Often this is because the information out there – in the form of academic articles – is highly technical and difficult for a non-expert to decipher. And even if policymakers are fortunate enough to find the technical terms familiar, synthesising the available literature to form sound, evidence-based policy is something they don't have time for.

To bridge the gap, organisations like POST (the Parliamentary Office for Science and Technology in the UK) support decision makers by collating and assessing policy-relevant information and briefing policymakers accordingly. Young scientists can help collate this information too. Across the UK, PhD students can take part in a 3-month internship with parliamentary bodies in England (POST), Scotland (The Scottish Parliament Information Centre) and Wales (The Research Service) as well as other organisations involved in policymaking. In just three months, students can produce a formal briefing for policymakers, contribute to the development of a policy workshop, or take part in a policy enquiry, all of which bring scientific research skills and expertise to the policy domain. The Science and Technology Options Assessment unit of the European Parliament (STOA) runs a similar programme for those who have completed their PhD. Fellows spend six months sharing their expertise with policymakers in either Luxembourg, Strasbourg or Brussels, where they contribute to the evidence base for European policy.

Those beyond their PhD can take part in a number of other fellowships to aid the transfer of science into policy. NERC (Natural Environment Research Council) Policy Placement Fellowships, for example, allow environmental science researchers to work closely with UK policymakers in departments aligned with their expertise. Policymakers are also brought into research institutes as part of the scheme. Michelle Cain, a postdoctoral researcher from the University of Cambridge and EGU Atmospheric Sciences Young Scientist Representative, undertook an 18-month-long policy placement fellowship with Defra (the UK government's Department for Environment and Rural Affairs), where she brought her modelling expertise to their Air Quality Evidence Team.

"I was able to devote more time to a particular project than would otherwise have been spent on it and provide recommendations towards developing a new strategy for air quality modelling from an informed standpoint," Cain explains. While she didn't work directly with policymakers during her placement, the evidence team did, allowing her to help shape air quality policy at a national level. In turn, this will impact both human and environmental health across the country. "Having a good understanding of the science and the policy context (gained through such fellowships) can enable scientists to contribute towards the strategic direction of the government team they are working in," Cain adds.

Helping inform policymakers where you are will certainly impact your nation's use of geoscience in environmental policy, but the impact could be even wider. (Credit: Justin Green)

There are other ways you can share your expertise too, like providing your input in a public call for evidence, or by contacting your local government department regarding issues that fall within their areas of expertise. This evidence is collated to inform local and national policy decisions, which in turn can affect the way more wide-reaching policy is put in place.

Young scientists can work with the European Commission as well as their local government, bringing geoscience into policymaking at the national and the European level. (Credit: Giampaolo Squarcina)

Scientist-policymaker pairing schemes also help bridge the gap between research and policy. The Royal Society in the UK, The Academy of Sciences in France and STOA in Belgium all run pairing schemes that allow scientists to spend a set time in parliament, and parliamentarians to make a reciprocal visit to the scientist's institute. These parings tend to be aimed at mid-stage researchers, rather than those just starting out, but are an excellent way to find middle ground in the fields of science and policy. These schemes let scientists learn about how policy is formed and what policymakers need from scientists, as well as enabling policymakers to understand more about the way research is carried out.

Scientists can directly contribute to policymaking at the European level by working with the European Commission and the organisations that support it. The European Commission hosts 5-month-long traineeships that immerse scientists in the workings of EU policy. From organising consultations to writing reports and literature research, the positions let scientists bring their expertise to the table and equip them with skills to further channel their science into policy. The Organisation for Economic Co-operation and Development, with headquarters in Paris, France, offers similar internships for students in the environmental, agricultural and social sciences. While these internships are unpaid, they do offer a great insight into policymaking in Europe.

The reach of young scientists in policy can go even further though, with organisations like Emerging Leaders in Environmental Policy (ELEEP) bringing together young scientists from Europe and North America to exchange ideas, policy solutions and best practices relating to both energy and the environment. ELEEP connects young scientists with an interest in policy on both sides of the Atlantic through study tours, conferences and an online forum for the exchange of information and expertise.

ELEEP member and postdoctoral researcher Edvard Glücksman highlights what the network brings to its members: "ELEEP offers a broad network of contacts and learning opportunities, which in turn allows members to make more informed and measured decisions... Many members will eventually take on policy-making positions in the future. To that end, the ELEEP experience will have offered them vital first-hand experience learning about a range of areas in environment and energy." When forging any career, experience is vital and networks like this are an important way to build it (if you want to get involved in policymaking full-time, Science magazine has some fantastic suggestions to help forge your career).

ELEEP members gather in Rotterdam's port area during a study tour in the Netherlands. (Credit: Edvard Glücksman)

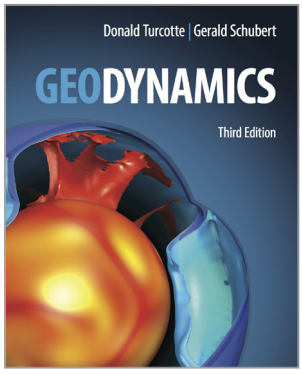
"I am particularly proud of our ongoing Arctic outreach fellowships, which we created from nothing during an ELEEP summit last year… These fellowships embody the true spirit of ELEEP, harnessing background expertise whilst at the same time offering young professionals a chance to step outside their comfort zone through first-hand experience with a globally important subject matter," Glücksman adds. And there are more exciting initiatives ahead: "the network itself, now three years old, is in the process of developing new and innovative ways of harnessing members' expertise in a more publicly accessible manner," something that will not only benefit policymakers, but the general public too.

The input of young scientists in policy can bring about not just local, national or European change, but change on a global level. Whether you choose to move to policymaking, synthesise information for policymakers or provide evidence in a public call, one thing's for sure: every step you take could lead to a global impact, and change the way science is used in policymaking.

Sara Mynott

Former EGU Communications Officer (from September: PhD student in marine biology at the University of Exeter)

Geodynamics



By Donald L. Turcotte, Gerald Schubert

CAMBRIDGE UNIVERSITY PRESS

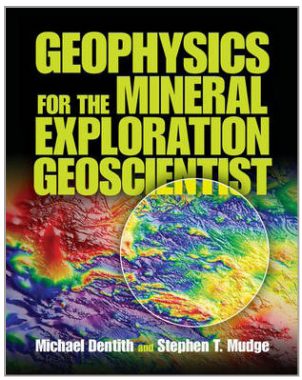
636 pages | Paperback
3rd edition | June 2014
ISBN 9780521186230

Price: £47.50 (~€60)

Publisher's summary

Essential reading for any Earth scientist, this classic textbook has been providing advanced undergraduate and graduate students with the fundamentals needed to develop a quantitative understanding of the physical processes of the solid Earth for over thirty years. This third edition has two completely new chapters covering numerical modelling and geophysical MATLAB applications, and the text is now supported by a suite of online MATLAB codes that will enable students to grasp the practical aspects of computational modelling. The book has been brought fully up to date with the inclusion of new material on planetary geophysics and other cutting edge topics. Exercises within the text allow students to put the theory into practice as they progress through each chapter and carefully selected further reading sections guide and encourage them to delve deeper into topics of interest. Answers to problems available within the book and also online, for self-testing, complete the textbook package.

Geophysics for the Mineral Exploration Geoscientist



By Michael Dentith, Stephen T. Mudge

CAMBRIDGE UNIVERSITY PRESS

454 pages | Hardback
1st edition | April 2014
ISBN 9780521809511

Price: £45 (~€56)

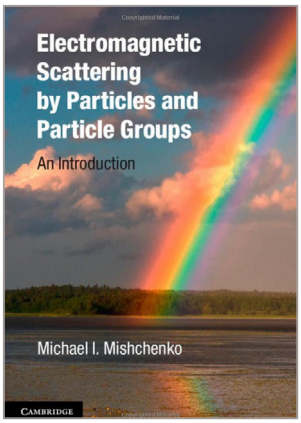
Publisher's summary

Providing a balance between principles and practice, this state-of-the-art overview of geophysical methods takes readers from the basic physical phenomena, through the acquisition and processing of data, to the creation of geological models of the subsurface and data interpretation to find hidden mineral deposits. Detailed descriptions of all the commonly used geophysical methods are given, including gravity, magnetic, radiometric, electrical, electromagnetic and seismic methods. Each technique is described in a consistent way and without complex mathematics. Emphasising extraction of maximum geological information from geophysical data, the book also explains petrophysics, data modelling and common interpretation pitfalls. Packed with full-colour figures, also available online, the text is supported by selected examples from around the world, including all the major deposit types. Designed for advanced undergraduate and graduate courses in minerals geoscience, this is also a valuable reference for professionals in the mining industry wishing to make greater use of geophysical methods.

BACK TO CONTENTS

Electromagnetic Scattering by Particles and Particle Groups

An Introduction



By Michael I. Mishchenko

CAMBRIDGE UNIVERSITY PRESS

450 pages | Hardback
1st edition | April 2014
ISBN 9780521519922

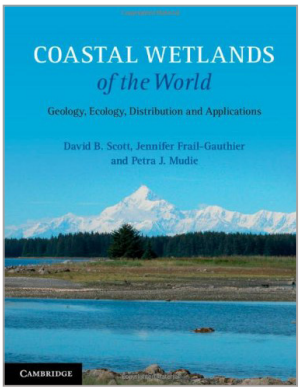
Price: £45 (~€56)

Publisher's summary

This self-contained and accessible book provides a thorough introduction to the basic physical and mathematical principles required in studying the scattering and absorption of light and other electromagnetic radiation by particles and particle groups. For the first time the theories of electromagnetic scattering, radiative transfer, and weak localisation are combined into a unified, consistent branch of physical optics directly based on the Maxwell equations. A particular focus is given to key aspects such as time and ensemble averaging at different scales, ergodicity, and the physical nature of measurements afforded by actual photopolarimeters. Featuring over 120 end-of-chapter exercises, with hints and solutions provided, this clear, one-stop resource is ideal for self-study or classroom use, and will be invaluable to both graduate students and researchers in remote sensing, physical and biomedical optics, optical communications, optical particle characterisation, atmospheric physics, and astrophysics.

Coastal Wetlands of the World

Geology, Ecology, Distribution and Applications



By David B. Scott, Jennifer Frail-Gauthier, Petra J. Mudie

CAMBRIDGE UNIVERSITY PRESS

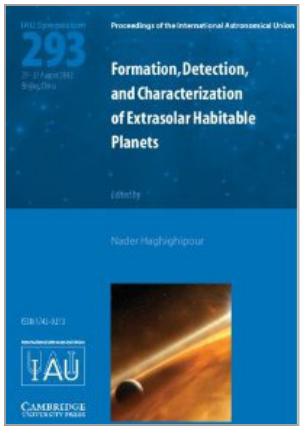
496 pages | Paperback
1st edition | March 2014
ISBN 9781107628250

Price: £37.50 (~€47)

Publisher's summary

Salt marshes and mangrove forests, the intertidal wetlands of the world's coastlines, provide key ecological services to all areas of the globe. This cutting-edge, richly illustrated book introduces the essential elements of coastal wetlands and their applications. The book opens by introducing coastal oceanography, the physical features of wetlands, their ecology, and human impacts upon them, giving all students the necessary background for wetlands studies. It then presents detailed case studies from around the world with extensive illustrations, supplying a wider, global-scale picture of wetlands geomorphology and biodiversity. The final chapters discuss some unique applications of coastal wetlands, including geological monitoring, uses in biotechnology and agriculture, and various experimental mesocosms. This is ideal as supplementary reading to support students on a wide range of Earth and life science courses, from environmental science, ecology and palaeoecology to geomorphology and geography. It will also be a valuable interdisciplinary reference for researchers.

Formation, Detection, and Characterization of Extrasolar Habitable Planets (IAU S293)



Edited by Nader Haghighipour

CAMBRIDGE UNIVERSITY PRESS

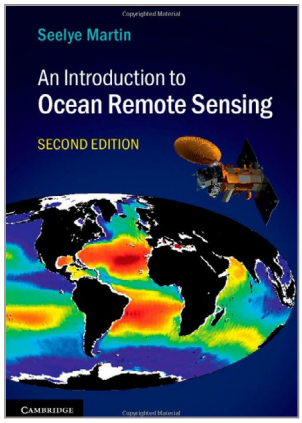
476 pages | Hardback
1st edition | May 2014
ISBN 9781107033825

Price: £76 (~€96)

Publisher's summary

This discovery of several Earth-like planets within the habitable zones of their host stars has triggered extensive research on the formation, dynamical evolution, interior dynamics, and atmospheric characteristics of extrasolar habitable planets. IAU Symposium 293 presents a collection of articles on the state-of-the-art research on these topics, including new discoveries of habitable exoplanets. The volume starts by reviewing the current state of the detection of habitable planets, and after guiding the reader through the most recent theoretical and observational achievements on the discovery and understanding of potential life-harbouring bodies, concludes by presenting the reader with a review of the upcoming missions that search for Earth-like planets around other stars, and the likely signatures of extraterrestrial life. This comprehensive, up-to-date and technical volume targets those seeking to understand the origin of life and the possibility and detection of life elsewhere in the Universe.

An Introduction to Ocean Remote Sensing



By Seelye Martin

CAMBRIDGE UNIVERSITY PRESS

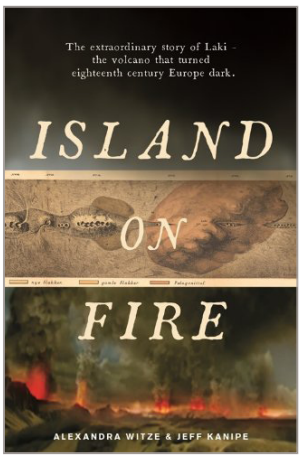
521 pages | Hardback
2nd edition | March 2014
ISBN 9781107019386

Price: £50 (~€63)

Publisher's summary

Fully updated, with significant new coverage of advances in satellite oceanography and results from new satellite missions, the second edition of this popular textbook introduces students to how remote sensing works, how to understand observations from Earth-observing systems, and the observations' importance to physical and biological oceanography. It provides full explanations of radiative transfer, ocean surface properties, satellite orbits, instruments and methods, visible remote sensing of biogeochemical properties, infrared and microwave retrieval of sea surface temperature, sea surface salinity retrieval, passive microwave measurements, scatterometer wind retrieval, altimetry and SAR. Also included are descriptions of the online archives where data can be obtained, and readers can obtain online tools for working with the data – enabling hands-on engagement with real-world observations. This is an ideal textbook for graduate and advanced undergraduate students in oceanography, remote sensing and environmental science, and a practical resource for researchers and professionals working with oceanographic satellite data.

Book review: Island on Fire



By Alexandra Witze and Jeff Kanipe

PROFILE BOOKS

224 pages | Hardback
1st edition | March 2014
ISBN 978-1781250044

Price: £7.69 (~€10)

Volcanoes are no unusual sight in Iceland and yet the eruption that started on June 8, 1783 in the southern district of Síða was something never seen before. In the following eight months, an estimated 14 cubic kilometres of lava poured out from 135 fissures opening north of the town of Klaustur covering some 2,500 square kilometres of land and threatening to overrun not only many of the surrounding farms but the town itself. The volcanic ash carried away by the wind poisoned the land, killing half of the Icelandic cattle population and a quarter of the sheep and horse population. In the resulting famine (1783–1784), an estimated nine thousand people, one-fifth of the population of Iceland, died.

But the eruption of Laki – as this new formed chain of volcanoes was named – had possibly even more widespread effects. In the years that followed the event, the climate in Europe deteriorated and the exceptional hot summer of 1783 was followed by long and harsh winters. The resulting crop failures may even have triggered one of the most famous insurrections of starving people in history, the French Revolution of 1789–1799 (though the French peasants had many other, mostly political and financial, reasons to overthrow the government). Other accounts for droughts, exceptional cold winters and floods are known, from North America to Japan, spanning the years 1783 to 1785.

Despite its apparent disastrous impacts on the environment, society and history, the Laki eruption is little known outside Iceland or specific geological publications. Many books (and even movies) have popularised Mount Vesuvius in Italy, Mount St. Helens in the U.S., or the great Krakatoa eruption in Indonesia. However, a popular account of the Laki eruption was missing.

Authors Alexandra Witze and Jeff Kanipe have closed this gap with Island on Fire. In this book, they present Laki's extraordinary story based on the accounts of the eruption found in contemporary documents, letters, newspaper articles and diaries, describing both the terrifying sight of the lava fountains and ash clouds In Iceland, and the years of anomalous weather and increased death rates in Europe. Interviews with volcanologists and climatologists all over the world provide context and explanation to these historic observations. Finally, the authors also visited the modern Síða district in search of surviving traces, both in the landscape and in the local communities, of the fires of Laki.

The book is subdivided in nine chapters. Every chapter explores in text, black and white images, diagrams and maps how Laki's effects spread over the eighteenth-century world, focusing on the European continent, where its impacts were strongest. A final section with endnotes provides recommended reading and references, including the used historical sources, modern scientific publications and some websites.

Chapter one sets the scene by introducing us to an extraordinary man and eyewitness of the first hour of the developing catastrophe, the clergyman in Klaustur and self-taught naturalist Jón Steingrímsson (1728–1791). His detailed description of the eruption and its aftermath forms the narrative backbone of the book. Chapter two is dedicated to basic geologic concepts, presenting also a short geological history of Iceland. It introduces the volcanoes in Laki's immediate neighbourhood, like Hekla, the 'gateway to hell', or Eyjafjallajökull, a volcano that became famous almost 230 years after the Laki eruption. Chapter three goes beyond Iceland, shortly summarising the most famous historic and prehistoric eruptions worldwide and their impacts on human history and culture.

The following chapters are dedicated to the historic descriptions of seemingly unexplainable phenomena observed all over Europe in 1783, such as a strange haze, sometimes followed by a stench, that appeared in the sky. At the time only few naturalists recognised its composition (fine volcanic ash and gaseous compounds) and origin from an Icelandic volcano. Shading the Earth from the sun and disrupting local weather systems, the arrival of the volcanic ash was usually followed by heavy rain or hail and a marked drop in temperatures. Resulting floods and storms killed people immediately. Long winters and cool summers with lowered productivity of crops had disastrous long-term effects on entire societies, based mostly on agriculture for sustenance, as described in the book.

The final chapters give a detailed overview of how volcanoes can kill, exploring the volcanic threat that our modern society still faces. The authors give examples from old eruptions, such as the one that destroyed the Roman town of Pompeii more than 2000 years ago, focusing then on more recent events and how they can affect us. The eruption of Eyjafjallajökull in 2010, for example, although of relatively moderate dimension, became a political and financial disaster. Planes and passengers were grounded for weeks due to concerns about the possibility that the volcanic ash could damage aircraft engines. The book points out that ash clouds with the characteristics of the 1783 fog could possibly paralyse the entire air traffic of the northern hemisphere and threaten the health and lives of many.

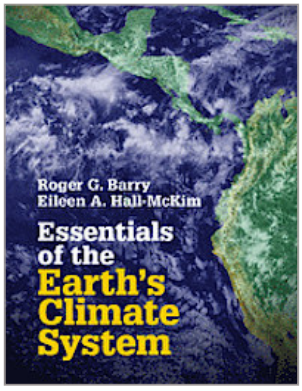
The existing detailed documentation of Laki and its climatic effects is also of great interest for atmospheric scientists. Recent volcanic eruptions with marked cooling effects, like Pinatubo in 1991, where situated near to the tropics, where wind patterns and atmospheric circulations are relatively simple and well understood. However the

rarity of great volcanic eruptions near the poles has posed great problems to scientists, trying to develop climate models fitting the particular atmospheric patterns found there. So it is still controversial whether the exceptional hot and dry summer of 1783 was a direct consequence of the Laki eruption (as the ash adsorbed and scattered both sunlight and moisture) and only later atmospheric circulation dispersed the ash in such a way that the cooling effect, as seen following modern eruptions, prevailed. This is also explored in the book.

In the end one thing is certain – the title of the book could easily be Planet on Fire, rather than Island on Fire, as the two authors take the reader, starting from Iceland, on a great journey around the globe, showing how different civilizations through centuries were, and still are, influenced by volcanoes. I can only recommend this book to geology- and history-enthusiasts alike.

David Bressan
Freelance geologist based in Italy

Book review: Essentials of the Earth's Climate System



By Roger G. Barry and Eileen A. Hall-McKim

CAMBRIDGE UNIVERSITY PRESS

271 pages | Paperback
1st edition | March 2014
ISBN 9781107620490

Price: £35 (~€43)

Understanding the Earth's climate system is a fundamental part of any atmospheric or Earth science curriculum. When talking about climate, it is important to remember that climate science incorporates the description of key variables and concepts, climatic zones as well as climate change and its implications to society.

Essentials of the Earth's Climate System, by Roger G. Barry and Eileen A. Hall-McKim, is a comprehensive introductory textbook that covers all aspects of the climate system. It is specifically written for a one-semester course in climate science and does not assume prior knowledge beyond a basic understanding of scientific principles. Mathematical equations are mostly omitted in favour of a combination of descriptive texts and colour figures that illustrate most concepts.

Designed for coursework, each chapter starts with an outline of the key concepts and finishes with a brief summary as well as review questions. While most questions require the student to explain a specific process or highlight important aspects, there are also questions that encourage students to work with freely available climate data and to explore climate phenomena. The text itself is divided into short sections, each covering one concept, variable or aspect of climate. These paragraphs are densely packed with facts, scientific theory and applications, but remain easy to read due to the accessible language. Even experienced scientists will find new and relevant information in this book, so that it might serve as a short reference. Throughout the book there are a multitude of text boxes that provide additional information about important scientists or interesting climate features and events such as the Tibetan Plateau or the Dust Bowl. This encourages students to do further reading.

The book contains 12 chapters that can be grouped into four sections. After a brief introduction, chapters two and three introduce climate variables such as energy, moisture and wind. Chapters four to eight, introduce the reader to processes and elements of the climate system, such as microclimates, general circulation, teleconnections, synoptic climatology and land-sea interactions. Chapter nine gives an overview over different climate types and gives examples of the differences within each climatic zone. The last three chapters deal with past and future climates, as well as current applications and implications of climate science. The book also contains an extensive glossary of terms used in the book and links to climate and weather data. There is also as additional information on topics such as monsoons or teleconnections.

To give the reader an impression of the general style of this book, I provide two examples of how topics are covered. The concept of evaporation is addressed on four and a half pages. After a brief introduction to the concept and latent heat, the book provides some history on the work of Penman and modifications of the equations named in his honour, without actually providing the equations, and introduces direct measurement methods, linking them to the FLUXNET network. Then evapotranspiration is introduced and linked to climate classification. The authors provide global maps of evaporation and introduce the concepts of water balance, drought and moisture indices.

The section on monsoons as a climate type establishes the seasonal nature of monsoonal climates and extensively links the upper air circulation over Eastern Asia to rainfall characteristics in the region. Similarly monsoon systems in West Africa, Australia and even North and South America are described.

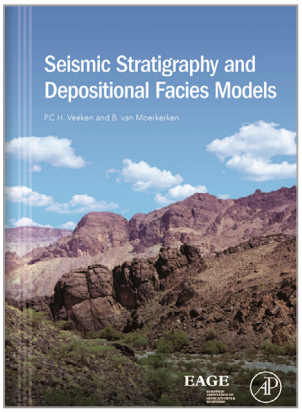
Compared to other climatology textbooks, the authors present a lot of information that goes beyond the explanation of basic scientific concepts, such as historic overviews and current applications. Additionally, climate classification is treated more extensively than in many other books. It is my impression that the focus of the book is

on the description of climate elements, given the amount of information and the focus on classification. As a consequence, sometimes the climate's nature as a complex system of physical processes does not get transported as well as it could.

Overall, the content of Essentials of the Earth's Climate System is very extensive and well researched. It serves well both as a reference and a basis for an introductory class in climatology.

Tobias Gerken
Postdoctoral Researcher, Meteorology Department
Pennsylvania State University, USA

Book review: Seismic Stratigraphy and Depositional Facies Models



By P.C.H. Veeken and B. van Moerkerken

EAGE PUBLICATIONS

496 pages | Hardback
1st edition | 2013
ISBN 9789073834439

Price: €100 (€80 for EAGE members)

The interpretation of sedimentary deposits from seismic data provides crucial information for a correct evaluation of hydrocarbon reservoirs. During the last few decades, seismic stratigraphy has improved the recognition and reconstruction of the depositional history of basins, saving time and economical resources by optimising the accuracy of subsurface predictions. This improvement in hydrocarbon exploration has led to a significant increase in oil production and estimation of recoverable reserves.

The Seismic Stratigraphy and Depositional Facies Models textbook by Paul C.H. Veeken and Bruno van Moerkerken, provides a systematic approach for the description and evaluation of subsurface reservoirs. The authors have an extended career as geoscience consultants, having spent over 25 years working in the oil and gas industry. Their experience has contributed to provide a clear and detailed description of the 'hot topics' relating to seismic interpretation and modelling techniques, supplying advanced tools for the recognition of sedimentary facies.

The book represents a reference guide for geologists, geophysicists and engineers working on hydrocarbon exploration. It is subdivided into four main sections full of clarifying figures, diagrams and field examples, following step by step the recipe for a correct and accurate interpretation of depositional sequences and sedimentary environments from seismic profile data. The textbook provides an introduction to seismic methods, focusing on the basic principles of seismic reflection and the behaviour of seismic waves as they travel through the Earth´s interior. It pays particular attention to seismic stratigraphic techniques and the expression of sedimentary units through seismic profiles. To familiarise the reader with the geophysical background, the authors often use visual examples and real-world case studies to describe complex concepts and clarify jargon. The nature of sedimentary units, for instance, is described using case examples and field photographs, including basic rules for the interpretation of potential reservoirs within the different units.

Aiming to reconcile the formation of hydrocarbon reservoirs with major events occurred in our planet, the authors also present parallel issues related to interesting aspects about the origin of life and major events in the geologic history of Earth. These final notes aim to help the reader understand the importance of facies recognition on the evolution and characterisation of oil and gas reservoirs.

The textbook strengths lie in the easy way the authors present key concepts and explanatory notes, establishing useful links between cause- and- effect relationships in seismic interpretation. However, the book lacks a more detailed description of the reservoir characterisation modelling techniques. It limits itself to offering a general overview of the processing techniques and the analysis of seismic markers that may help junior professionals with seismic interpretation.

All in all, the book successfully integrates seismic interpretation techniques and stratigraphic criteria aiming to evaluate, from a practical point of view, the characterisation of potential reservoirs. It includes a large amount of data that is successfully condensed into a useful and easy-to-read book.

Javier Fernández Lozano
Postdoctoral Research Fellow, Department of Geology, University of Salamanca

BACK TO CONTENTS

GEOQ EVENTS

This section advertises conferences, summer schools and workshops submitted to the EGU online meetings calendar. The EGU logo marks meetings co-sponsored by the Union.

Please note that events submitted to the calendar without description or website may not be highlighted here.

Biogeochemical Interfaces in Soil: Towards a comprehensive and mechanistic understanding of soil functions

06–08 October 2014, Leipzig, Germany

The symposium aims at annealing different approaches and concepts developed in soil physicochemistry, soil hydrology and soil ecology to identify factors controlling the architecture of biogeochemical interfaces.

Website: http://bit.ly/SPP1315

Mega Earthquakes and Tsunamis in Subduction Zones: Forecasting approaches and implications for hazard assessment

06–08 October 2014, Rhodes Island, Greece

This workshop will count with the participation of experts, young scientists and representatives of international organisations from around the globe. The programme includes oral and poster presentations, discussions and social events.

Website: http://www.gein.noa.gr/metsz/

SCOSTEP's 13th Quadrennial Symposium on Solar-Terrestrial Physics

12–17 October 2014, Xi'an, Shanxi, China

This symposium of the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) will present results from two scientific programmes: Climate and Weather of the Sun Earth System and Variability of the Sun and Its Terrestrial Impact.

Website: http://stp13.csp.escience.cn/dct/page/65540

16th SEISMIX International Symposium on Multi-scale Seismic Imaging of the Earth's crust and Upper Mantle

12–17 October 2014, Castelldefels (Barcelona), Spain

The main topic of this symposium will be the structure of the crust and upper mantle of the continents and their margins using controlled source seismic methods. Special emphasis will be devoted to the recent advances that provide images of the crust and upper mantle with unprecedented detail.

Website: http://bit.ly/SEISMIX

14th European Astrobiology Conference

13–16 October 2014, Edinburgh, UK

The focus of the EANA 2014 conference will be 'Signatures of Life' from fossils to trace gases and other ways in which extant and extinct life can be detected on Earth and beyond. However, all other topics in astrobiology are welcome.

Website: http://www.astrobiology.ac.uk/eana2014/

Chemical Atmosphere-Snow-Sea Ice Interactions: Taking the next big steps in the field, lab & modelling

13–15 October 2014, Cambridge, UK

The aim of this three-day workshop is to bring together experimental and theoretical scientists who work on the physics, chemistry or biology of the atmosphere-snow-sea ice system in order to discuss research status and challenges, which need to be addressed in the near future.

Website: http://bit.ly/CASSII

8th International Symposium on Eastern Mediterranean Geology

13–17 October 2014, Mugla, Turkey

This symposium aims to provide a permanent platform for experts in geology, geophysics, mining and other geosciences to share and

BACK TO CONTENTS

discuss their recent work and hereby establish international networks among several disciplines of geosciences.

Website: http://isemg.org/

World Research and Innovation Congress Oceans

15–16 October 2014, Lisbon, Portugal

This congress brings together the global scientific marine community, funding agencies, policymakers, non-governmental organisations and other stakeholders, providing a forum to discuss the key issues facing oceans research today.

Website: http://wric-oceans.com/

2014 GSA Annual Meeting

19–22 October 2014, Vancouver, Canada

Discover new science in the hundreds of sessions, trips, courses, and events. The Geological Society of America meeting is where geoscience professionals come to get engaged, get educated, get inspired, and enjoy each moment.

Website: http://www.geosociety.org/meetings/2014/

Réunion des Sciences de la Terre (Earth Sciences Meeting)

27–31 October 2014, Pau, France

The RST 2014 proposes 10 themes encompassing all disciplines of geosciences, from deep Earth to superficial envelopes and planetary bodies. This congress also aims at favouring contacts between scientists from different research fields.

Website: http://rst2014-pau.sciencesconf.org/

Earth Observation for Ocean-Atmosphere Interactions Science 2014

28–31 October 2014, Frascati, Italy

This conference jointly organised by ESA, SOLAS (Surface Ocean Lower Atmosphere Study) and EGU aims at bringing together scientists involved in the observation, characterisation and forecasting of ocean-atmosphere interactions.

Website: http://www.eo4oceanatmosphere2014.info/

Earthquakes: Nucleation, triggering, and relationship with aseismic processes

03–10 November 2014, Cargèse, Corsica

The goal of this training school is to give PhD students, post-docs and young scientists an accurate snapshot of our current understanding of how earthquakes nucleate and can be triggered, in light of recent improvements.

Website: http://earthquakes.sciencesconf.org/

Lithosphere 2014 Symposium

04–06 November 2014, Turku / Åbo, Finland

This symposium focuses on understanding the structure, composition and evolution of the lithosphere in Fennoscandia and is aimed at all geoscientists working with related issues.

Website: http://www.seismo.helsinki.fi/ilp/lito2014/index.html
Abstract deadline: 3 October 2014

6th EGU Leonardo Conference on Hydrological Precipitation, Evaporation and Runoff Droughts

13–14 November 2014, Prague, Czech Republic

These conferences focus on topical questions related to water and its interactions with environment and society, with particular attention for water resources management, flood risk mitigation and environmental protection.

Website: http://www.eguleonardo2014.com/

10th Workshop of the International Lithosphere Programme ILP-Task Force on Sedimentary Basins

16–20 November 2014, Jeddah, Saudi Arabia

The Task Force on Sedimentary Basins of the International Lithosphere Programme welcomes contributions linking deep and shallow processes in sedimentary basins of the Arabian peninsula plate and surrounding areas, as well as works and papers dealing with geohazards related to structural behaviour, tectonic evolution, seismicity and volcanic activity.

Website: http://www.geosoc.fr/ilp2014-jeddah/topics.html

Analysis and Management of Changing Risks for Natural Hazards

18–19 November 2014, Padova, Italy

The main objectives of this conference are to contribute to a better knowledge of the interaction of natural, engineering, economical and human sciences on risk management, and to highlight the fact that planning information is vital in terms of assisting the planning and development processes as well as effectively reducing the risks.

Website: http://www.changes-itn.eu/Conference/tabid/132/Default.aspx

Establishing Europe-wide Minerals Reporting Standards

20–21 November 2014, Brussels, Belgium

This conference aims to promote the adoption of a common reporting standard in the EU. Such an approach will contribute to the convergence of terminology and the comparability/compatibility of data, thus facilitating the creation of a solid European Knowledge Database on mineral resources and to the successful delivery of the Raw Materials Initiative.

Website: http://eurogeologists.eu/conferences/

2014 National Soil Science Conference

23–27 November 2014, Melbourne, Australia

Soil Science Australia invites you to join us at the National Soil Science Conference which will be held in November 2014. The conference programme will cover the breadth of soils, landforms and climate across the region, and the corresponding breadth of land use: from agriculture to forestry, conservation, recreation and urban use. There really is something in this conference for everyone concerned with understanding and managing soils.

Website: http://www.soilscience2014.com/

The Effects of Irrigation and Drainage on Rural and Urban Landscapes (IRLA2014)

26–28 November 2014, Patra, Greece

The 1st International Symposium regarding the Effects of Irrigation and Drainage on Rural and Urban Landscapes (IRLA2014) will bring participants together to discuss up-to-date knowledge, recent research results and technological advances under the theme of the conference.

Website: http://irla2014.irrigation-management.eu/

International Workshop on Polar-Lower Latitude Linkages and their Role in Weather and Climate Prediction

10–12 December 2014, Barcelona, Spain

The workshop's overall aim is to improve the polar components of the tools used for weather and climate prediction, including enhanced initialisation, which may lead to improved forecasts in the extra-polar regions. The workshop will consist of key note talks by invited speakers, poster sessions, breakout group sessions and a plenary session. The expected outcome is producing a set of recommendations that will be broadly disseminated as a report.

Website: http://www.polarprediction.net/index.php?id=58

2014 AGU Fall Meeting

15–19 December 2014, San Francisco, United States

The Fall Meeting of the American Geophysical Union provides an opportunity for researchers, teachers, students, and consultants to present and review the latest issues affecting the Earth, the planets, and their environments in space. This meeting will cover topics in all areas of Earth and space sciences.

Website: http://fallmeeting.agu.org/2014/